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PEDESTRIAN CROSSWALK SIGNAL ACTIVATION DEMONSTRATION

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TRANSPORTATION DEVELOPMENT CENTRE

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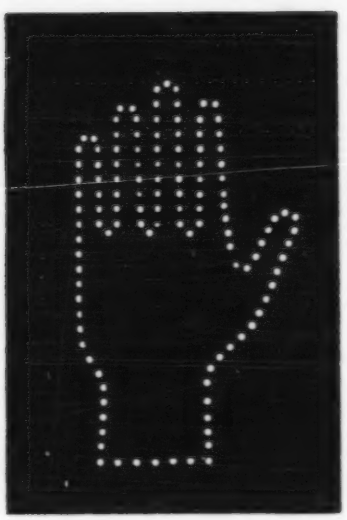
PEDESTRIAN CROSSWALK SIGNAL ACTIVATION DEMONSTRATION



by

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March 1987

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Un sommaire en français de ce document est inclus avant la table des matières.

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17. Abstract

This report presents a detailed description of the design, fabrication and installation of a new pedestrian crosswalk signal activation device. The prototype device had the unique capabilities of being able to vary crossing times for the benefit of elderly and disabled pedestrians, and of providing audible and visual signal status information. The device was installed by the City of Edmonton on a demonstration basis in February, 1987, in a downtown residential area. Technical and user evaluations of the prototype control device are included. Recommendations are made for the further development and manufacture of the device. Design drawings are provided.

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17. Résumé

Le présent rapport donne une description détaillée de la conception, de la fabrication et de l'installation d'un nouveau dispositif de commande de feux de circulation pour passage piétonnier. Le prototype mis à l'essai présentait la caractéristique unique de pouvoir faire varier la durée de la phase "traversez", en fonction des personnes âgées et des handicapés; il était également équipé de signaux, sonore et visuel, indiquant l'état du système. Le dispositif a été installé en février 1987, par la ville d'Edmonton, à titre de projet de démonstration, dans un secteur résidentiel du centre-ville. On trouvera également dans le rapport une évaluation technique du système, les observations des utilisateurs et les recommandations formulées en vue du perfectionnement et de la fabrication éventuelle du dispositif. Des dessins d'étude accompagnent le rapport

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SUMMARY

Background

To mark 1985 as International Youth Year (IYY), the Transportation Development Centre (TDC) of Transport Canada sponsored a student design competition for improved pedestrian crosswalks based on the safety and accessibility needs of the elderly and the disabled. A detailed description of the design competition is contained in "Student Design Competition for Pedestrian Crosswalks - An International Youth Year Project" (TP 7346E).

Subsequent to the IYY project, TDC arranged for the publication of two of the submissions and the construction and demonstration of a pedestrian crosswalk control device based on another winning design. This report provides a detailed description of the design, development, and demonstration of the prototype pedestrian signal activation device.

Demonstration Project

The innovative crosswalk control device developed in the submission entitled "How the Turtle Crossed the Road", by fourth-year Industrial Design students Brian Jenkins and William Reynolds at the University of Alberta, was judged to be the best candidate for a demonstration project. The concept developed by the students was that of a pedestrian-activated crosswalk control system installed in a post on the sidewalk and having the capability of varying the pedestrian crossing time. The control system would be equipped with two buttons: one for fast walkers providing for a standard crossing time; and one button that would increase the crossing time for elderly and disabled persons. This crosswalk system was given the name "Turtle Crosswalk" by the students because of the added protection given to slower pedestrians.

The Transportation Department of the City of Edmonton agreed to co-sponsor the demonstration project. The site selected by the City for installation of the prototype signal device was located within the Oliver subdivision, which is an older neighbourhood immediately to the west of the downtown area of the City. The neighbourhood contains significant numbers of elderly persons.

The design of the prototype control device began in late August, 1986, and was substantially complete by November, 1986. Fabrication of the components began in November, 1986, and assembly was completed in January, 1987. The overall cost of the demonstration project was estimated to be $50,000 (see Section 3.5 on page 16 of the report). The prototype control devices were delivered to the City of Edmonton in January, 1987, and installed in February, 1987.

Functional Design

The control system developed for the Turtle Crosswalk is housed in a steel box installed in a reinforced concrete pedestal mounted on the sidewalk (as shown in Figure 3.1 on page 8 of the report). The control system is equipped

with two activation buttons. The top button is labelled "PUSH FAST WALK". Pushing this button provides a crosswalk "WALK" interval of 7 seconds (when the "WALK" symbol is on) plus a clearance period of 11 seconds (when a "FLASHING HAND" symbol is on) for a total crossing time of 18 seconds. The lower button, which is labelled "PUSH", is more easily accessible to children and persons using wheelchairs. Pushing this button results in an extension of the "clearance period" ("FLASHING HAND") by 6 seconds for a total crossing time of 24 seconds. The visual sequence of events for the Turtle Crosswalk is as follows:

- When a pedestrian first approaches the control device, a red "HAND" (don't walk) symbol is displayed.

- Pushing either of the two activation buttons generates a one-half second "BEEP" sound on a speaker facing the pedestrian and lights three "CLOCK" symbols and a flashing "WAIT" sign, acknowledging the request to cross.

- At intervals of 15 seconds, the "CLOCK" symbols are turned off, denoting the passage of time.

- When a pedestrian crossing can be accommodated, the traffic controller changes the signal facing the vehicular traffic to "AMBER". then "RED" and then activates the green "WALK" (person) symbol in place of the "HAND" symbol. A second audible signal of one-half second is used to alert the waiting pedestrian. The "WALK" symbol remains on for 7 seconds.

- After a walk interval of 7 seconds, the traffic controller replaces the "WALK" symbol with a "FLASHING HAND" symbol for a clearance period of either 11 seconds if the upper "PUSH FAST WALK" button was pushed, or 17 seconds if the lower "PUSH" button had been pushed.

- At the end of the clearance period, the "HAND" symbol ceases to flash, but remains on until one of the two buttons are pushed again.

Evaluation

For the purpose of this report, the demonstration phase of the project was necessarily short because of a completion date for TDC involvement of March 31, 1987. The Transportation Department of the City of Edmonton plans to monitor the project for a one-year period ending in February 1988.

To accommodate the needs of this report, arrangements were made to obtain perceptions of the prototype device from users in the adjacent seniors housing complex and to make spot observations of persons using the device on the street. The prototype traffic signal activation device was also reviewed and evaluated by the entire project team during the design, development and installation stages. The intent of this evaluation was to provide advice for other installations and for the potential mass production of the device in the future.

(a) User Evaluation: Nine of the ten residents that responded to a survey distributed in the adjacent seniors housing complex indicated that the control device was:

- appropriate for the residential area;
- helpful to be located on the sidewalk; and
- helpful in providing more crossing time.

Eight of the residents liked the new control buttons which they found to be:

- easy to locate;
- easy to push; and
- easy to understand.

(b) Technical Evaluation: The City technical staff concluded that:

- More sun shielding or higher lighting intensities are required to ensure that the displays do not wash-out in direct sunlight.
- The design needs improvement from the point-of-view of field maintenance and durability.
- The design needs further simplification to reduce production costs.
- A much simpler, smaller, pole-mounted version of the device could be a more practical solution.
- The design is not yet applicable to typical installations because standard traffic control equipment does not provide for differentiation between two types of pedestrians.

(c) Benefits: The major benefits perceived from the demonstration project included:

- a greater awareness of traffic signal functions by pedestrians;
- improved information to the crosswalk users;
- reduced vehicle/pedestrian conflicts;
- an increased number of choices in appropriate pedestrian signal technology;
- potential for lower-cost replacements of other components of the traffic signal systems.

Conclusions

The overall conclusions of the evaluation were that:

- The prototype devices were operating satisfactorily.
- The users responded positively to the new technology.
- The design of the control device could be further simplified.
- Additional development work was required to satisfy the needs of the City.

Recommendations

The following are the consultants' recommendations with respect to the potential mass production of the Turtle Crosswalk device:

- A professional design firm should review the design.
- Material for the signal boxes could be either mild steel or aluminum, provided that stainless steel fasteners are used.
- A method of adjusting the level of the audibles should be provided.
- The design of the activator buttons and the pedestal mounts should be simplified.
- The access panels and weather seals should be improved.
- The LED lighting unit should be further developed.
- The signal boxes should be recessed in the concrete pedestals to resist vandalism and provide additional sun shielding.

SOMMAIRE

Généralités

Pour souligner l'Année internationale de la jeunesse (1985), le Centre de développement des transports (CDT) a parrainé un concours d'urbanisme réservé aux étudiants universitaires; ce concours était axé sur l'étude de passages piétonniers plus sûrs et plus accessibles, répondant aux besoins des personnes âgées et des handicapés. Pour une description détaillée du concours, se reporter au rapport TP 7346E, "Student Design Competition for Pedestrian Crosswalks - An International Youth Year Project".

Par la suite, le CDT a pris les arrangements nécessaires en vue de la publication de deux propositions soumises au concours, ainsi que de la réalisation et l'essai d'un prototype de feux de circulation pour passages piétonniers, fondé sur une soumission primée. Ce rapport présente une description détaillée de l'étude, du développement et de la démonstration du prototype.

Projet de démonstration

Le dispositif jugé le mieux adapté à un projet de démonstration est celui élaboré dans la proposition intitulée: "How the Turtle Crossed the Road", présentée par Brian Jenkins et William Reynolds, deux étudiants en quatrième année de Design industriel à l'Université de l'Alberta. Ce dispositif innovateur est un feu de circulation intégré dans une colonne en béton placée sur le trottoir, et que les piétons peuvent commander eux-mêmes pour faire varier la durée du signal "traversez". Le dispositif proposé comprend deux boutons: le premier pour les personnes pouvant traverser à vitesse normale, donnant donc un feu vert de durée standard; et le deuxième qui permet de prolonger la durée du feu vert, pour les personnes âgées et les handicapés. Le système a été appelé "Turtle Crosswalk" par ses deux concepteurs, en raison du temps de traversée plus long accordé aux piétons qui marchent lentement.

Le Service des transports de la ville d'Edmonton ayant accepté de participer au parrainage du projet de démonstration, il a été décidé d'installer le système dans la subdivision Oliver, un vieux quartier à l'ouest du centre-ville, où habite un nombre appréciable de personnes âgées.

L'étude du prototype a commencé vers la fin d'août 1986; elle était pratiquement terminée en novembre de la même année. La fabrication des divers composants a été entreprise en novembre, et c'est en janvier 1987 qu'on a terminé la réalisation du matériel. Le coût global du projet de démonstration a été évalué à 50 000 $ (se reporter à la section 3.5 du rapport). Le prototype a été livré à la ville d'Edmonton en janvier 1987, puis installé en février.

Fonctionnement du système

La commande du feu de circulation "Turtle Crosswalk" se trouve dans un boîtier en acier, installé dans une colonne en béton armé placée sur le trottoir (voir figure 3.1 du rapport). Ce feu comporte deux boutons de commande:

le bouton supérieur "POUSSER - MARCHE RAPIDE", alloue au piéton 7 secondes pour franchir le passage (intervalle compté à partir de l'apparition du signal "Traversez", plus un temps de dégagement de 11 secondes (à partir du clignotement du symbole de la main "Attendez"), ce qui lui donne un total de 18 secondes pour franchir le passage. Le bouton inférieur est marqué "POUSSER"; il est plus facilement accessible aux enfants et aux personnes en fauteuil roulant. En appuyant sur ce bouton, on prolonge le temps de dégagement (clignotement du symbole de la main) de 6 secondes, ce qui donne alors une durée totale de 24 secondes pour traverser. Voici en détail la séquence de fonctionnement du feu de circulation "Turtle Crosswalk:

- Lorsqu'une personne se présente devant le dispositif de commande, celui-ci affiche une main rouge, signifiant "Arrêtez".

- En appuyant sur l'un ou l'autre des deux boutons, le piéton déclenche un signal sonore "BIP" d'une demi-seconde, émis par un haut-parleur lui faisant face. En même temps s'allument trois symboles d'horloge et un signal clignotant "Attendez"; cette séquence confirme que le système a reçu la demande de passage.

- Les trois symboles d'horloge s'éteignent successivement à intervalles de 15 secondes, pour indiquer le temps écoulé.

- Dès que le programme de signalisation du carrefour le permet, le dispositif fait passer successivement au jaune et au rouge les feux régissant la circulation automobile, et le symbole "Arrêtez" est remplacé par le symbole "Traversez". Un deuxième signal sonore d'une demi-seconde se fait entendre pour avertir la personne en attente. Le symbole "Traversez" demeure allumé pendant 7 secondes.

- Après cet intervalle de 7 secondes, le symbole "Traversez" est remplacé par le clignotement du symbole "Arrêtez"; à ce moment-là, la personne dispose d'un temps de dégagement de 11 secondes si elle a utilisé le bouton supérieur "POUSSER - MARCHE RAPIDE", ou de 17 secondes, si elle a appuyé sur le bouton "POUSSER".

- Une fois écoulé le temps de dégagement, le symbole "Arrêtez" cesse de clignoter, restant allumé jusqu'à ce que l'un des deux boutons soit poussé à nouveau.

Evaluation

La date limite imposée par le CDT sur la production du présent rapport, soit le 31 mars 1987, a eu nécessairement pour effet d'écourter la durée de la démonstration. Par contre, le Service des transports de la ville d'Edmonton prévoit suivre le fonctionnement du carrefour pendant toute une année, c'est-à-dire jusqu'en février 1988.

Pour les fins du présent rapport, on a recueilli les impressions des utilisateurs du système résidant dans les habitations voisines pour personnes âgées et on a observé au hasard les réactions des personnes se servant du système. Par ailleurs, toute l'équipe du projet a procédé à un examen et à une évaluation du prototype à chacune des trois étapes suivantes: étude,

perfectionnement et installation du système. Cette analyse avait pour but de constituer une base d'informations qui pourraient servir à d'autres installations et être appliquées à une éventuelle fabrication en série du dispositif.

a) Evaluation - utilisateurs: Sur les dix personnes qui ont répondu au questionnaire distribué dans les habitations pour personnes âgées du voisinage, neuf ont considéré:

- que le système était bien adapté aux secteurs résidentiels;
- que son installation sur le trottoir le rendait pratique; et
- qu'il garantissait effectivement un temps accru pour le franchissement des passages piétonniers.

Huit personnes ont dit aimer le nouveau type de bouton proposé parce qu'il était:

- facile à repérer;
- facile à enfoncer; et
- facile à comprendre.

b) Evaluation technique: L'évaluation faite par la ville d'Edmonton a débouché sur les constatations suivantes:

- une protection améliorée contre les rayons du soleil ou une intensité lumineuse plus élevée sont nécessaires pour éviter l'effet de masque en plein soleil;
- le dispositif devrait offrir une meilleure maintenabilité sur place et une plus grande durabilité;
- il y aurait lieu de simplifier le dispositif afin de réduire les coûts de production;
- un dispositif plus simple, plus petit et monté sur poteau serait plus pratique; et
- le dispositif ne peut être adapté aux installations existantes, étant donné que les systèmes standard de régulation de la circulation ne permettent pas les variations de durée de phase sur commande.

c) Avantages: Les principaux avantages qui en découlent sont:

- une meilleure perception, par les piétons, de la signification des signaux affichés;
- une information plus complète des usagers des passages piétonniers;
- une réduction du nombre de conflits entre piétons et véhicules;
- un choix plus varié de techniques et matériels de signalisation piétonnière;
- une possibilité de remplacement, à plus faible coût, des autres composants des systèmes de régulation de la circulation.

Conclusions

Voici les conclusions générales de l'évaluation:

- Le fonctionnement des prototypes s'est révélé satisfaisant.
- Les utilisateurs du dispositif ont réagi favorablement à cette nouvelle technologie.

- La conception et la construction du dispositif de commande pourraient être davantage simplifiées.
- Des mises au point du dispositif ont été requises pour répondre aux exigences de la ville d'Edmonton.

Recommandations

Les consultants chargés de la réalisation du projet ont formulé les recommandations suivantes concernant la possibilité de fabriquer en série le dispositif "Turtle Crosswalk":

- La conception du dispositif devrait être revue par des experts en design.
- Le boîtier du dispositif pourrait être en aluminium ou en acier doux, pourvu que les fixations soient en acier inoxydable.
- Le dispositif devrait être équipé d'un moyen de réglage du niveau de l'avertisseur sonore.
- La conception des boutons de commande et des supports devrait être simplifiée.
- Les panneaux d'entretien et les étanchéités mériteraient d'être améliorés.
- L'ensemble à DEL devrait être perfectionné davantage.
- Le boîtier devrait être encastré dans la colonne en béton, ce qui lui donnerait une meilleure protection contre le vandalisme et le mettrait davantage à l'abri des rayons du soleil.

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GLOSSARY

Pedestrian-Activated Crosswalk: A crosswalk with traffic signals that normally assign the right-of-way to vehicular traffic unless a request to cross is entered by a pedestrian who pushes a signal-activation button.

Pedestrian Traffic Signal: This is the signal box or device containing the "WALK/WAIT" symbols or wording only.

"WALK" Interval: The period of time in which a pedestrian may enter a crosswalk. The traffic signal displayed to pedestrians is a "WALK" symbol or wording.

Minimum "WALK" Interval: The minimum duration of a "WALK" signal display during which the group of pedestrians who were waiting for this display can reach a reasonable distance in the crosswalk at a comfortable speed. It is normally not less than 7 seconds.

Clearance Period: The time required for the pedestrian who entered the crosswalk at the very end of the "WALK" interval to reach a safe refuge, at the opposite sidewalk, at a comfortable speed before a conflicting vehicular "GREEN" interval commences.

Traffic Signal Cycle: The period of time required for a traffic signal to complete one cycle of displays to traffic movements in both the east/west and north/south directions. In automated traffic control systems, the time required may be varied throughout the day depending upon the amount of vehicular traffic moving in each direction.

1.0 INTRODUCTION

Transport Canada is committed to fostering the development of new technology, systems and procedures that help make transportation services more accessible for elderly and disabled Canadians. For example, in September, 1985, the Transportation Development Centre (TDC) of Transport Canada sponsored an International Youth Year (IYY) project to encourage the development and implementation of improved pedestrian crosswalk design to better serve the needs of the elderly and the disabled. This IYY project took the form of a Student Design Competition during the period October 1, 1985, to March 31, 1986. Substantial prizes were awarded to assist students with further studies and/or encourage implementation of their designs.

Subsequent to the IYY project, TDC arranged for the publication of two of the student submissions and the implementation of a demonstration project in the City of Edmonton based on one of the award-winning designs.

This report describes the process that was followed in selecting student projects for implementation and in developing the Pedestrian Signal Activation Demonstration in Edmonton. A detailed description of the design and development of a prototype pedestrian signal activation device is provided.

1.1 THE STUDENT DESIGN COMPETITION

The design competition was open from November 15, 1985, to March 3, 1986, to senior undergraduate student teams (two or more students) and postgraduate students in colleges and schools of engineering, architecture, urban planning and environmental studies. Their designs were expected to incorporate such items as: crosswalk features and markings, street furniture, transit shelters, signage, transit information displays, and traffic control devices. Current and emerging technology was to be reviewed, with an emphasis on safety and other special needs of disabled and elderly pedestrians. A detailed description of the design competition is contained in a separate publication.(1)

A Design Awards Panel made up of practising engineers, architects and urban planners judged the student entries on the following criteria:

- potential for improvements in overall pedestrian safety;
- potential benefits to the elderly and the handicapped in terms of improved accessibility and safety;
- positive impacts on urban street design and environment;
- improvements in accessibility for the elderly and the disabled;
- positive impacts on automobile traffic and/or transit service;
- potential for implementation;
- benefits to career development and experience;
- overall technical soundness of the proposed system or methodology;
- overall quality of project report and presentation materials.

The award-winning designs as selected by the members of the Design Awards Panel were as follows:

First Place:	A McGill University submission by Torill Kove and Thomas Leathem
Second Place:	A University of Alberta submission by Brian Jenkins and William Reynolds
Third Place (tied):	University of Waterloo submissions by Laura Taylor and Scott Kapuscinski, and by Jason Chu, Eric Robida, Solon So and Veronica Tam
Fourth Place:	A Queen's University submission by Gaetan Royer
Honourable Mention:	A McMaster University submission by Dan Dillon and Wayne Roberts

1.2 SELECTION OF PROJECTS FOR IMPLEMENTATION

When the Student Design Competition for Pedestrian Crosswalks was first undertaken, it was expected to generate one or more student projects that could be implemented in the 1986-87 fiscal year. This was anticipated to require the purchase of special equipment and the employment of one or more of the students to implement their designs.

The potential for implementation of the winning designs was reviewed by the project team during the Student Design Comptition. In the case of guidelines or design manuals, "implementation" would entail editing and publishing the student project reports. In the case of a potential demonstration project, a municipal sponsor would be required. The selection was therefore based in part on a preliminary assessment of the local interest by municipal traffic officials in the student design. The final selection for a demonstration project by TDC necessarily depended upon both the available funding and the municipal response.

Following the awarding of prizes as described above, three projects were selected for implementation. The selections included two reports judged to be worthy of publication by TDC. These were:

- "A Guideline for the Design of Pedestrian Crosswalk Precincts", a University of Waterloo submission by fourth-year Planning students Laura Taylor and Scott Kapuscinski; and
- "Provisions for Elderly and Handicapped Pedestrians in the Manual of Uniform Traffic Control Devices for Canada", a McMaster University submission by fourth-year Engineering students Dan Dillon and Wayne Roberts that won an "honourable mention".

The innovative pedestrian-activated crosswalk control device developed in the submission entitled "How the Turtle Crossed the Road", by

fourth-year Industrial Design students Brian Jenkins and William Reynolds of the University of Alberta, was judged to be the best candidate for a demonstration project.(2)

1.3 IMPLEMENTATION

To implement the student projects, TDC engaged (by a contract extension) MANOP Services Ltd. of North Vancouver, who were the consultants managing the Student Design Competition. The consultants' work included:

- reprinting those student reports judged worthy of publication;
- publishing a limited number of copies of the above reports for review by professionals concerned with urban design and traffic engineering practice;
- employing one or more of the design students to complete their design so that it could be fabricated;
- managing the development of a prototype signal activation control device;
- selecting and purchasing any special equipment required;
- confirming the implementation site with municipal sponsors and providing liaison with the designers;
- monitoring implementation of the design;
- documenting the implementation process.

(a) Publications: Fifty copies of the Dillon/Roberts report noted above, entitled "Provisions for Elderly and Handicapped Pedestrians in the Manual of Uniform Traffic Control Devices for Canada", were reprinted for distribution by the Roads and Transportation Association of Canada (RTAC) for review by professionals concerned with traffic engineering practice in Canada.

Fifty copies of the Taylor/Kapuscinski report, entitled "A Guideline for the Design of Pedestrian Crosswalk Precincts", were reprinted for distribution by TDC for review by professionals concerned with urban planning practice in Canada.

(b) Demonstration Project: The concept contained in the Jenkins/Reynolds report, entitled "How the Turtle Crossed the Road", formed the basis for a demonstration project that is described in the following sections of this report.

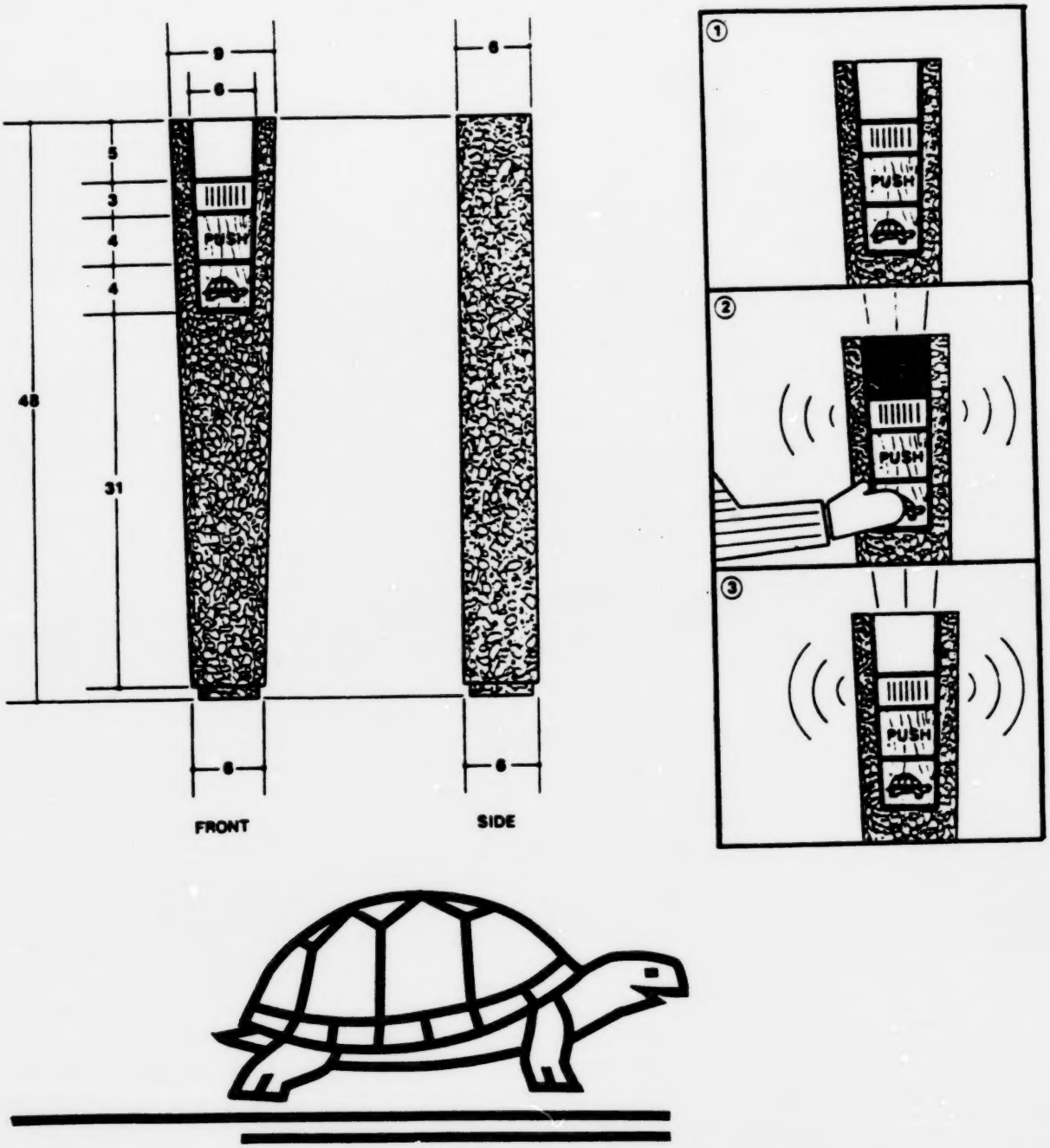


Figure 2.1 Illustrations from: "How the Turtle Crossed the Road"
(Dimensions in inches)

2.0 DEMONSTRATION PROJECT DEVELOPMENT

2.1 THE DESIGN PROPOSAL

Existing controls for typical pedestrian-activated crosswalks in Canada have many limitations which can be particularly troublesome for elderly and handicapped pedestrians. A recent report sponsored by TDC describes most of the problems, including the following:(3)

- Control buttons are often inaccessible to persons using wheelchairs and difficult to locate by persons with vision problems. For example, "seeing-eye dogs" are trained to keep such persons away from obstacles such as the poles upon which the controls are mounted.
- The sizes, shapes and pressures required to operate the control buttons vary considerably. For example, very small buttons equipped with hard springs are nearly impossible for persons with severe arthritis in their hands to operate.
- Since most controls do not respond in the manner of an elevator button, it is not possible to know if the signal button is activated until the signal changes or how long it will take for a signal change.

The concept developed by the University of Alberta Industrial Design students was that of a pedestrian-activated crosswalk control system installed in a post on the sidewalk and having the capability of varying the pedestrian crossing time (see Figure 2.1). The control system would be equipped with two buttons: one providing for a standard crossing time; and one button that would increase the crossing time for elderly and disabled persons who could require more time to cross a particular street. This innovative crosswalk system was given the name "Turtle Crosswalk" by the students because of the added protection given to slower pedestrians.

The students proposed to redesign an existing pedestrian-activated crosswalk to provide easier signal controls, longer crossing times when needed, orientation for the visually or hearing impaired, and integration into the streetscape. Overhead traffic sign messages were proposed to be enhanced. It was proposed to develop a design that could be used at any pedestrian-activated crosswalk. The City of Edmonton Transportation Department was solicited for interest in a possible demonstration project. The project was approved by the City in July, 1986.

2.2 MUNICIPAL SPONSOR

The City of Edmonton employs a computerized traffic signal management network. A traffic control centre is equipped with programs that optimize vehicular traffic flow through major arterial streets. The traffic programs allow the percentage of east/west versus north/south "GREEN TIME" at intersections to be varied throughout the day. Traffic police and technicians monitor actual traffic conditions, reporting unusual circumstances to the traffic control centre where programs can be modified to suit conditions.

Pedestrians are accommodated by creating "windows of opportunity" to cross within the traffic cycles. For example, at a pedestrian-activated crosswalk, pushing the access button activates the pedestrian crossing during the next cycle in which the opposing vehicular traffic is not flowing. The actual signals controlling the flow of vehicular traffic may be several intersections distant from the pedestrian crosswalk. If no one activates the signal, the vehicular flow is uninterrupted.

City of Edmonton traffic officials had responded positively to the intent of the design concept. The City Transportation Department had been concerned about the lack of a positive feedback of information to pedestrians activating crosswalk controls. A simple feedback device had been developed by Edmonton Power - Signals Section, which is responsible for traffic signal installations. One such device was installed by the City at the north side of the intersection of 83rd Avenue and 99th Street. At this location the pedestrian-activated crosswalk on 99th Street is equipped with two pole-mounted weatherproof electric control boxes. One box contains a large round pedestrian control button and the other a backlighted plexiglass sign that is turned on when the control is activated. The lettering on this sign was as follows: "CALL ENTERED WAIT FOR WALK". The proposed design was accepted as substantial improvement over the existing device.

The City technical staff were very supportive throughout the project. The City staff assisted the student designers to revise their original concept so as not to deviate too far from accepted and familiar concepts. City staff also designed and built the timer required to interface with the traffic signal controller. Without this support it would not have been possible to successfully complete the design and install the prototype devices.

2.3 INDUSTRIAL SUPPORT

The consulting team canvassed potential Edmonton and other Western Canadian suppliers for the necessary components for the construction of a prototype control device as conceived by the students. Suppliers and fabricators were found for most components in Edmonton, with alternative sources mainly in the Vancouver area. The required components included:

- precast concrete fabrication for the pedestals;
- metal fabrication for the boxes to house the electrical equipment;
- electrical components including wiring, switches, audibles and lighting systems;
- metal fasteners for insertion in both concrete and steel.

Two major suppliers expressed interest in supporting the development of a prototype control device. These included:

- Novax Industries Corporation of New Westminster, British Columbia, who are designers and original equipment manufacturers of traffic signal controllers; and
- Supercrete, a Division of Canada Cement Lafarge (known as Canfarge Ltd.) of Edmonton, who donated the concrete pedestals to the demonstration project.

2.4 SITE SELECTION

Officials of the City Transportation Department reviewed several potential crosswalk sites for the demonstration project. Initially, the City proposed to install the new pedestrian crosswalk signal control at the intersection of 83rd Avenue and 99th Street. At this location the City had already tested the positive feedback device described in Section 2.2 above. The installation would have benefited pedestrians crossing 99th Street, which is a major north/south arterial. This site was subsequently rejected because the existing traffic controller at the location did not offer sufficient flexibility to accommodate variations in crossing times.

The site finally selected for the demonstration project was the intersection of 104th Avenue and 120th Street. This site was selected for the following reasons:

- The crosswalk was located within the Oliver subdivision, which is an older neighbourhood immediately to the west of the downtown area of the City.
- The neighbourhood contained significant numbers of elderly persons in both single-family dwellings and high-density facilities.
- The crosswalk would directly accommodate a high-density residential complex for elderly persons.
- Pedestrians were being directed to the west side of this intersection because of substantial conflicts due to the volume of vehicle turning movements between 120th Street and the east side of the intersection.
- High volumes of both east/west traffic on 104th Avenue and north/south traffic on arterial streets in close proximity to the selected intersection resulted in a long wait between "WALK" cycles.
- Pedestrians and cyclists had been observed to be ignoring both the crosswalk restriction to the west side only and the "DON'T WALK" display. Crossing between intersections was also quite common in this area.
- The Honeywell Model HMC-1000 traffic controller at this location was capable of accommodating crossing time variations;
- The crosswalk accommodated a bus stop with a shelter and a bench;
- Pedestrian volumes were significant;
- The existing crosswalk was in need of improvements;
- The residents in the area have indicated a desire to reduce conflicts between vehicle and pedestrian traffic.

Photograph by
Bill Reynolds
(View South)

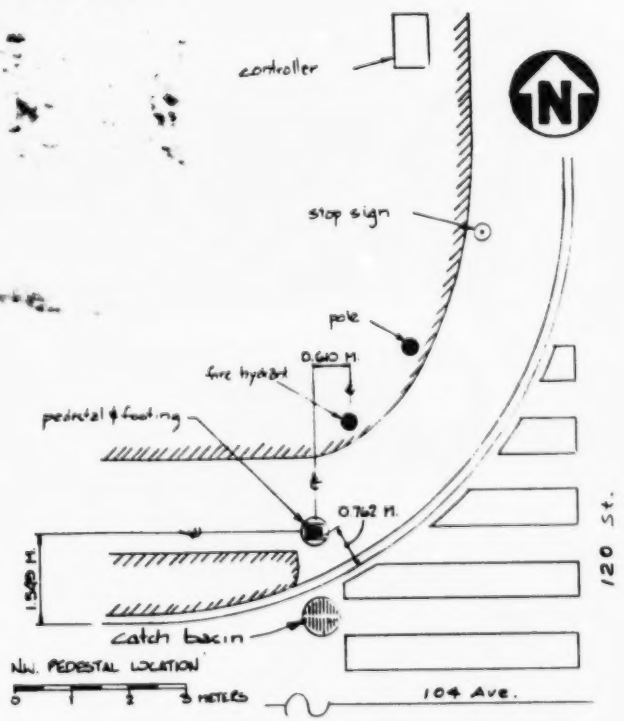


Figure 3.1 Location of Turtle Crosswalk Device
(On the north side of intersection)

3.0 PROTOTYPE DESIGN AND FABRICATION

The design of the prototype control device began in late August, 1986, and was substantially complete except for modifications to the internal lighting system and lenses by November, 1986. Fabrication of the components for four devices began in November, 1986, and assembly was finally completed in January, 1987. The prototype control devices were delivered to the City of Edmonton in January, 1987. (See Section 3.7 for events in chronological order.)

3.1 FUNCTIONAL DESIGN

The prototype system developed for the Turtle Crosswalk is housed in a steel control box installed in a reinforced concrete pedestal mounted on the sidewalk as shown in Figure 3.1. The control box contains several aids to pedestrians using the crosswalk. These include:

- a lighted display of the pedestrian crosswalk signals at eye level;
- both audible and visual responses when the control buttons are pushed so that the request is acknowledged plus a "WAIT" indicator;
- a visual indication of the passage of time as the pedestrian waits for the "WALK" symbol to appear;
- an audible signal when the "WALK" (person) symbol appears indicating that pedestrians may enter the crosswalk;
- a choice of two crossing times.

The control system is equipped with two pedestrian-activation buttons. The top button is labelled "PUSH FAST WALK". Pushing this button provides a crosswalk "walk interval" of 7 seconds (when the "WALK" symbol is on) plus a "clearance period" of 11 seconds (when the "FLASHING HAND" symbol is on) for a total crossing time of 18 seconds. The lower button which is labelled "PUSH" is more easily accessible to children and persons using wheelchairs. Pushing this button results in an extension of the clearance period ("FLASHING HAND") by 6 seconds for a total crossing time of 24 seconds. (See Glossary for definitions.) These crossing times are designed for typical walking speeds for the intersection selected. Installations at other locations would require crossing times based on the width of the particular street being crossed.(4)

Figure 3.2 illustrates the visual sequence of events for this particular crosswalk which is as follows:

(1) When a pedestrian first approaches the control device, a red "HAND" (don't walk) symbol is displayed.

(2) Pushing either activation button generates a one-half second "BEEP" sound on the speaker facing the pedestrian and lights the three "CLOCK" symbols and the "WAIT" sign, acknowledging the request to cross. The "WAIT" sign flashes.

(3) At intervals of 15 seconds the "CLOCK" symbols are sequentially turned off, denoting the passage of time.

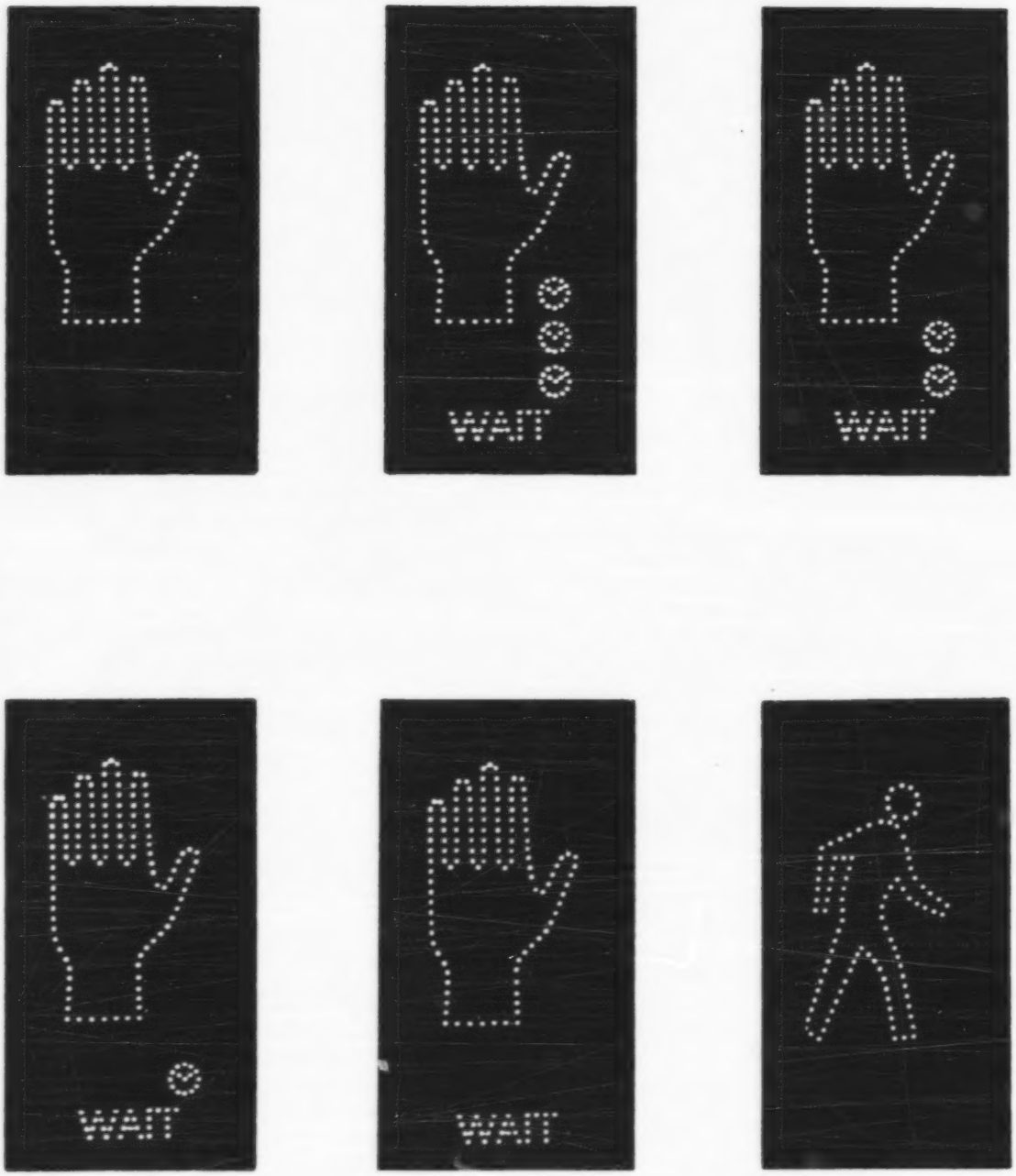


Figure 3.2 Crosswalk Display Sequence

(4) At the first opportunity in the traffic signal program that a pedestrian crossing can be accommodated, the program changes the traffic signal facing the vehicular traffic to "AMBER", then "RED" and then activates the green "WALK" (person) symbol in place of the red "HAND" symbol. A second audible signal of one-half second is used to alert the waiting pedestrian. The "WALK" symbol remains on for a walk interval of 7 seconds.

(5) At the end of the 7 second walk interval, the traffic program replaces the green "WALK" symbol with a red "FLASHING HAND" symbol for a clearance interval of either 11 seconds if the upper "PUSH FAST WALK" button was pushed, or 17 seconds if the lower "PUSH" button was activated originally.

(6) At the end of the clearance period, the red "HAND" symbol ceases to flash, but remains on until one of the two activation buttons are pushed again.

3.2 DESIGN OPTIONS CONSIDERED

(a) Functional Design: The consulting team reviewed several functional design options with Traffic Operations staff of Edmonton Transportation. These options included:

- development of the pedestrian crosswalk signal control device as a replacement for existing control buttons with provision for visual and audible response to a request to cross;
- development of the device as a replacement for pedestrian traffic signal displays as well as signal controls;
- development of the control device as a replacement for existing control buttons with provision for both visual signal displays and multiple audible responses.

In consultation with the City staff, the last option above was selected.

(b) Symbol Options: The Manual of Uniform Traffic Control Devices for Canada provides that:(5)

> "Pedestrian indications shall consist of two symbols: the walking pedestrian and the hand outline.
>
> The walking pedestrian symbol shall consist of a lunar white symbol on black background.
>
> The hand outline symbol shall consist of an orange silhouette of a hand on black background.
>
> The pedestrian signal lenses shall be not less than 30 cm square and the illuminated symbols shall be similar in shape to those illustrated in Figure B-1 (of the Manual).
>
> When illuminated the pedestrian signals shall be legible, under all normal conditions of visibility, from a minimum distance of 30 m and located not less than 2.5 m above the sidewalk."

The colour standard is not rigidly adhered to. Examples can be found in Edmonton and in other Canadian cities of combinations of RED/GREEN, ORANGE/GREEN, and RED/WHITE colours used for pedestrian signals.

RED/GREEN combinations are commonly used in the United States of America. The City officials expressed a preference for the use of red rather than orange, and since RED/GREEN combinations are presently in use, particularly in the downtown intersections, it was decided that this combination on a black background was acceptable for the prototype device.

Figure B-1 above refers to older style symbols that are no longer being used. The modern symbols now being used by traffic signal manufacturers are shown in Figure 3.2. It was therefore decided to use modern symbols identical in size to the existing signal devices which meet the above specifications.

It was not necessary to meet the size and shape standards above for the prototype control device since it was not replacing an existing signal. However, it was considered desirable to meet the standards so that the design would have the potential of being produced as a replacement unit in the future.

(c) Metric Versus Conventional Dimensions: In reviewing the proposed design with the steel fabricators, it was found that most manufacturers preferred to work in conventional (imperial) dimensions. The concrete fabricators could work in either metric or imperial units, while the electrical components were specified in imperial dimensions. For simplicity of fabrication, it was therefore decided by the designers to work only in imperial dimensions.

(d) Other Design Considerations: Other design considerations included:

- the external appearance in the urban environment;
- durability under extreme weather conditions;
- sidewalk intrusion and safety;
- a breakaway mounting in case of a vehicle collision;
- the electrical wiring code requirements.

3.3 MATERIAL AND COMPONENT SELECTIONS

Several options were considered for each of the various components of the prototype signal control devices. These components included:

- the support pedestal;
- the signal box;
- the activation buttons;
- the electrical components;
- the fasteners;
- the lighting unit.

Except for the lighting unit, which is described in Section 3.4, the following text describes the selections made.

(a) Support Pedestal: Materials considered for the support pedestal included:

- stainless steel;
- painted steel;
- exposed aggregate concrete;
- smooth reinforced concrete.

Precast concrete with an exposed aggregate finish was selected based on the advice of the supplier. Threaded inserts for mounting the pedestrian signal boxes, for side reflector panels and for the lower access door to the anchor bolts were set into the concrete forms to become imbedded in the concrete pedestal.

(b) Signal Box Material and Finish: Materials considered for the signal box to house the controls and the lighting unit included:

- stainless steel;
- anodized aluminum;
- galvanized steel;
- painted mild steel;
- rectangular steel or aluminum sections.

The fabricators employing automated presses to fabricate the boxes expressed some concern about working in stainless steel. Their preference was to fabricate the boxes in galvanized steel, mild steel or aluminum. In addition, fabrication in either stainless steel or aluminum presented some difficulties in removing stress marks and achieving a black background for the lighted symbols. Both would require etching before painting. Similar painting problems would occur with pre-galvanized steel. After consultation with the paint shops in Vancouver, it was decided to select mild steel and use an electrostatic paint process to achieve the necessary black background for the symbols.

(c) Activation Buttons: The desired features of the signal activation buttons were:

- large surface for ease of activation;
- durable finish;
- electrical isolation;
- ease of installation;
- legibility of instructions.

After reviewing available materials and fabricators, it was decided to design the buttons in hardwood. The material selected was two layers of maple with the laminations turned 180^{0} for strength and with the anchor bolts mounted between the layers of wood. The instructions were scroll cut into the hardwood to a depth of one-eighth inch, filled with black paint and finished with several coats of clear polyurethane. The student designers proposed to use the "TURTLE" symbol on one activation button and a "PUSH" symbol on the other. Because of the concerns of the City staff, the messages on the buttons were provided as described previously in Section 3.1.

(d) Electrical Switches: Three types of electrical switches were considered. These included:

- pressure or "membrane" switches;
- proximity switches;
- micro-switches.

The designers preferred to use proximity switches, however these require a constant source of power. The City staff advised that micro-switches should be used because this type of switch would work better with the remote traffic controller. It was anticipated that proximity switches could send a false signal to the controller.

(e) Audibles: Several audible systems were considered to aid the vision-impaired. These included audibles with the ability to monitor ambiant noise levels and adjust their output so as not to disturb the neighbourhood during periods of relative quiet. It was not possible to locate such devices within the time frame of the project so that standard piezo-electric audibles were selected.

Two frequencies were selected to distinguish between a signal acknowledgement and a signal change. These were utilized as follows:

- front upper speaker (facing pedestrian) - an intermittent "beep";
- rear lower speaker - a "chirp" noise.

(f) Security Fasteners: Security fasteners were used to fasten the rear access cover plates to the signal boxes. These special screws had an oval-shaped head that required a matching screwdriver with an oval socket. The screw heads were sloped to discourage loosening with pliers and are designed to look like rivets to discourage vandalism.

3.4 LIGHTING UNIT SELECTION

Existing traffic signals employ a number of different lighting sources. These include:

- incandescent bulb systems;
- neon systems;
- fibre-optics systems.

There were a number of trade-offs between initial cost and subsequent maintenance costs with these systems. Systems that use high output incandescent bulbs have a relatively lower first cost, but require more frequent bulb replacement. There is also some degradation of lighting output as the bulbs age. Neon and fibre-optics systems are more expensive. Neon requires high voltage exciters.

The City of Edmonton advised the consultants that existing fibre-optics systems were requiring more frequent replacement of the light source than anticipated. The City requested the designers to examine other options.

In addition to these considerations, the designers were attempting to keep the space envelope as small as possible. The incandescent bulb options appeared to be difficult to fit into a small container and the amount of heat radiated was a concern due to possible distortion of the activator mechanism. Neon was rejected because of a concern not to employ high voltages (2000 volts) at the pedestal and the large transformer required.

The designers reviewed several other options including:

- edge-lighted symbols scroll-cut in plastics;
- symbols formed out of lighted plastic tubing;
- symbols formed from acrylic rods;
- symbols cut out of fluorescent plastics;
- symbols formed from configurations of Light Emitting Diodes (LED's).

Edmonton suppliers of plastic signs produced samples of the first three options above and Novax Industries Corporation in New Westminster produced a sample sign using LED's. The three plastic symbol options were rejected because they did not have sufficient light output for daylight conditions. The symbols lost visibility under conditions of sunshine. The LED unit appeared to be the best option.

(a) Design of LED Lighting Unit: The LED prototype lighting unit was designed and developed by Novax Industries Corporation. It was purchased as a product with the design rights being retained by the supplier. This resulted in a minimum cost to the project.

The LED unit consists of an integrated circuit board containing all of the required symbols outlined by LED's in the appropriate colours. The circuit board is mounted in an aluminum frame. Negative images of the symbols are silk-screened in black on the back of a plexiglass frame cover. This cover is glued to the top of the aluminum frame to further protect and enhance the LED symbols. High-output LED's were used. The result is a lighting unit that is highly visible under a variety of external light conditions.

(b) Power Supply: The City officials requested that the power supply to the pedestals be a nominal 115 volts A.C. supply. This required the installation of step-down power transformers in the prototype signal boxes because the LED circuits were designed to operate on 24 volt power.

It would have been possible to wire the "HAND" and "WALK" symbols for 115 volts by putting all of the 1 1/2 volt LED's in series, but in the event of a circuit board failure the entire symbol would have been lost. The smaller "CLOCK" and "WAIT" symbols used fewer LED's in any case, so the power supply was established as 24 volts. This permitted series/parallel wiring combinations so that in the event of a circuit board failure, only a portion of a symbol would be lost.

(c) Timing Device: The necessary timing device to activate the various lighting circuits was built by the Engineering Department of Edmonton Transportation. The timer was located within the cabinet housing the traffic signal controller at the site (see Figure 2.1 for location). This timing device provided the necessary interface between the traffic controller and the pedestrian-activated control box mounted in the pedestal.

(d) Wiring: Internal wiring for all components of the signal box, including the audibles and the micro-switches, was provided by Novax Industries Corporation. In addition, Novax supplied a wired set of manual switches so that one of the prototypes could be used as a demonstration unit. External wiring was provided by the City.

The two pedestal bases were provided with an underground PVC tube containing thirteen #14 gauge wires which provided the necessary connection to the timing device in the traffic control cabinet.

3.5 DEVELOPMENT COSTS

The development costs for the demonstration project included costs borne by TDC and the City of Edmonton. The value of the City costs were estimated by the consultants resulting in the following cost allocations:

(i)	Project management, prototype design and monitoring (TDC)	$36,000
(ii)	Prototype fabrication (TDC)	4,000
(iii)	Signal timer design and fabrication control system modifications, and installation (City)	10,000
	TOTAL	$50,000

The material costs for four prototype devices, including the pedestal and base plates, are shown below. The "estimated value" is that which would have been paid if all supplier costs had been incurred for the four working units only.

Units	Component	Estimated Value	Actual Cost
2	Cardboard mock-ups	$ -	$ 150
4	Concrete pedestals	1,200	45
4	Steel boxes	1,702	1,702
-	Painting steel boxes	100	100
8	Hardwood buttons (2 per unit)	323	323
8	Micro-switches (2 per unit)	137	137
8	Audibles (2 per unit)	257	257
6	Lexan covers (2 spares)	132	176
4	LED units and power supply	1,500	1,000
-	Fastening devices and wiring	100	100
-	Sealing compounds	25	25
-	Turtle logos	-	54
	Total	$5,476	$4,069

In production the cost of fabrication of the steel boxes would be considerably less, probably in an order of magnitude of 50 percent. The concrete pedestals would likely cost about $200 each in quantity. A simpler method of producing the hardwood buttons would also lower these costs. In production the unit costs were estimated to be about $850 for a single-sided display and $1,050 for a complete unit with a two-sided display. These unit costs for a prototype compare with the current cost of a fibre-optics signal head of $600 to $800 per unit.

3.6 DESIGN DRAWINGS

Representative drawings used in the fabrication of the various components of the Turtle Crosswalk device are included in the Appendix section of this report. All dimensions shown on the drawings are in inches unless otherwise noted. The drawings are one-half size reductions of the original fabrication drawings so that the scales shown must be doubled (e.g. 1/2" = 1" becomes 1/4" = 1").

3.7 EVENTS IN CHRONOLOGICAL ORDER

The following were the important events that occurred during the development of the prototype signal activation control in chronological order.

1986

July 28	Demonstration project approved by the City.
Aug. 12	Letters sent to potential suppliers soliciting interest.
Aug. 19	Mobilization meeting with student designers. Decision to build four prototype units.
Aug. 26	Potential demonstration sites, sources of materials, and technology options reviewed with City officials.
Aug. 29	Site location confirmed by the City as 104th Avenue and 120th Street.
Sept. 8	Pedestal foundation requirements established. Symbol sizes determined. Neighbourhood demographics obtained.
Sept. 19	Traffic signal timing confirmed. Sidewalk location confirmed. Cost estimates for prototype signal device established.
Sept. 22	Supercrete agreed to fabricate and supply pedestals at no charge to the project. Sample of plexiglas lighting unit obtained. Light tube options examined. City agreed to intersection improvements.
Sept. 25	Security fasteners located. Turtle symbol on activator buttons rejected by the City.

Sept. 29	Proximity switches rejected by the City. Design drawings completed for signal boxes. Material lists revised.
Oct. 10	Source of audibles located. Footing design completed. Wiring requirements confirmed.
Oct. 16	Activator button wording confirmed. Plastic lighting unit samples rejected.
Oct. 20	Decision to fabricate signal boxes in Vancouver due to unavailability of support staff in Edmonton after October 31st.
Oct. 22	Novax Industries Corporation agreed to provide sample of LED lighting unit.
Oct. 29	Concrete pedestals fabricated. Symbol colours confirmed. All construction materials confirmed. Novax design concept accepted by the City.
Nov. 7	Footings for two pedestals installed by the City.
Dec. 5	Steel boxes completed and painted. LED lighting units ordered. Timing device constructed by the City.
Dec. 24	LED lighting system completed.
1987	
Jan. 16	Lighting units received. Prototype pedestrian signal boxes assembled. Pedestals put in place by the City.
Jan. 21	Prototype signal boxes delivered to the City of Edmonton.
Jan. 30	Testing of prototype signal completed by the City.
Feb. 10	Prototype signal boxes installed in pedestals.
March 31	Project monitoring completed.

4.0 INSTALLATION AND EVALUATION

The necessary components for four complete prototype signal controls were delivered to the City of Edmonton in January, 1987. This included the concrete pedestals, the four steel boxes containing the control devices, the wiring instructions and the fastening devices. Two of the prototype devices were installed by the City in early February, 1987, to control the selected crosswalk (previously described in Section 2.4 on page 7 of this report). One of the steel boxes containing the control device was wired to a set of switches that allowed the device to be used as a portable demonstration unit. This allowed the prototype devices to be demonstrated and evaluated in actual service as well as in a controlled environment.

The City installed the prototype signal control devices on a demonstration basis with the intention of evaluating the devices in-service over a one-year period. Because of a contractual requirement with TDC to complete this report as at March 31, 1987, the in-service evaluations were necessarily limited to seven weeks experience. This was not considered to be a problem because of extensive testing of the devices before installation and the severe weather conditions during the seven-week period. As of May 15, 1987, the devices were working satisfactorily. More recent information can be obtained by contacting the City of Edmonton officials listed under Acknowledgements on page iv.

4.1 NEIGHBOURHOOD SERVED

The Turtle Crosswalk is located within the Oliver subdivision in Census Tract 31, Area 5 as shown in Figure 3.1 on page 8. The demographics of Area 5 as of July 31, 1986, were as follows:

Total number of residential units	909
Owner units	20 (2%)
Total population	1,101
Employed population (full-time)	442 (40%)
Part-time employees	33 (3%)
Retired population	448 (41%)
Children and students	178 (16%)

This neighbourhood is quite stable for a rental area with 31 percent of the population having lived in the same residence for 5 or more years. The unemployment rate is only 4 percent among residents. The working population is about equally divided between males and females, however the large retired population is 63 percent female.

4.2 FUTURE AMENITIES AND OPTIONS

(a) Modifications to the Intersection: The City of Edmonton intends to make a number of improvements to the intersection at this location to enhance the safety and effectiveness of the crosswalk. These modifications include:

- the installation of curb-cuts for wheelchair users;
- renewal of all pavement markings;
- improvement of "DO NOT CROSS" signage on the east side of the intersection;
- improvement of pavement surface.

It was not possible to complete this work prior to the onset of winter weather conditions in 1986. The work was expected to be completed during the summer of 1987.

(b) Signal Box Options: The signal boxes were designed with removable steel inserts in the back panels. It would be possible to replace the steel inserts with lexan inserts in the future and install a second LED lighting unit facing the street. This would allow the pedestal units to supplement the existing overhead pedestrian signals as pedestrians could view the signal units on the opposite sides of the street. The City Traffic Operations staff were not in favour of using the pedestal signals alone as it was felt that the overhead signals had greater visibility. In addition, there was concern that passing vehicular traffic would obscure the far-side pedestal signal.

The City expressed interest in the possibility of using a smaller version of the signal boxes in a pole-mounted configuration as a replacement for existing pedestrian signals in the future.

4.3 PROTOTYPE EVALUATION

The prototype traffic signal activation devices were evaluated for functional performance and durability by City technical staff and the project team during development and fabrication. The City technical staff tested the mechanical and electrical components prior to installation. Further evaluation of the practicality of the devices by the City and the project team took place during their installation and the initial seven weeks of an approximate one-year demonstration period. At the end of this seven-week period, a survey was distributed in the immediate area to elicit user perceptions of the value of the new crosswalk control devices.

(a) User Evaluation: To accommodate the needs of this report within the time available, arrangements were made to obtain a sample of user perceptions of the prototype signal control device from residents of the adjacent seniors housing complex seven weeks after installation. In addition, comments were solicited from pedestrians during brief observations on the site by members of the consultant team.

The local residents appeared generally to be well aware of the new signal control device. Nine out of ten residents that responded from the adjacent seniors housing complex indicated that the control device was:

- appropriate for the residential area;
- helpful to be located on the sidewalk; and
- helpful in providing more crossing time.

Eight out of ten of the same residents liked the new control buttons. They were found to be:

- more easily located;
- more easily pushed; and
- the wording was easy to understand.

Only two out of ten persons were not fully aware that the control system provided a choice in crossing times. The following comments were also received:

> "This system will be a big improvement especially during fall and winter - in the past the button was very difficult to get to at times."
>
> "At first most persons believed that the signal would change to "WALK" in a shorter time. Even the longer "WALK" signal does not give the handicapped people much time."
>
> "Because one of the crosswalk devices is offset from the crosswalk, there is a tendency by some pedestrians to push the control button and then move to the curb edge, rather than watch the display."
>
> "There is an expectation that the signal will change to "WALK" when the last clock display goes out."
>
> "More explanation is needed for the two sets of push buttons."

(b) Technical Evaluation: In addition to the user evaluation, the City technical staff evaluated the installation for ease of installation, maintenance and for durability. The comments of the City staff included the following:

- More sun shielding or higher lighting intensities are required to ensure that the displays do not wash-out in direct sunlight.
- The design needs improvement from the point-of-view of field maintenance and durability.
- The design needs further simplification to reduce production costs.
- A much simpler, smaller, pole-mounted version of the device could be a more practical solution to the need for pedestrian feed-back.
- The design is not yet applicable to typical installations because standard traffic control equipment does not provide for differentiation between two types of pedestrians.(16)

4.4 BENEFITS OF THE DEMONSTRATION PROJECT

The Demonstration Project resulted in benefits to the following:

- student designers;
- City Transportation Department;
- industrial suppliers;
- pedestrians in general;
- elderly and disabled persons.

(a) Student Designers: The project gave the student designers their first opportunity to be employed in their chosen profession. To date, one of the students benefited from this experience in obtaining subsequent employment with a design firm.

(b) City Transportation Department: The City Traffic officials benefited from the opportunity to test new traffic technology at a minimum cost. With a major portion of the design and development costs borne by Transport Canada, the City was able to confine municipal costs to the control system modifications and the installation and monitoring of the devices. The City also expects to incur several spin-off benefits from increased knowledge of the potential for new technology to replace other components of the traffic signal system in the future.

(c) Industrial Designers: The Demonstration Project provided for three major components which have the potential for mass production. These components were:

- the concrete pedestal;
- the steel signal box;
- the lighting unit.

In addition, several local suppliers could benefit if a large volume of components were needed.

(d) Pedestrians in General: All pedestrians in the area of the demonstration benefited by the overall improvement in the crosswalk facilities. The major benefits perceived from the demonstration project included:

- a greater awareness of traffic signal functions by pedestrians;
- improved information to the crosswalk users;
- reduced vehicle/pedestrian conflicts.

(e) Elderly and Disabled Persons: The major benefits to the elderly and disabled were:

- additional crossing time;
- more easily accessed control buttons;
- audible and visual reinforcement of signal status information.

4.5 OVERALL CONCLUSIONS

The overall conclusions of the evaluation were that:

- The prototype devices worked satisfactorily in service.
- The users responded positively to the new technology.
- The design of the control device could be further simplified.
- Additional development work was required to satisfy the needs of the City.

5.0 RECOMMENDATIONS

As a result of the consultants' experience with the demonstration project, recommendations can be made for the development of new traffic signal devices or the continuation of the development of the prototype signal activation device and for their manufacture in quantity. These recommendations result from suggestions and advice received from all of the participants in the development and demonstration of the prototype device.

5.1 PROTOTYPE DEVELOPMENT

The development of prototype devices is a high-risk process. Because of this, support is often provided by governments in the form of tax credits or direct financing. Industries will undertake the development process if the potential market is perceived to be significant. In the case of special technology where the market for the device is uncertain, support for the development is needed from government research and development agencies such as TDC, for example.

This particular demonstration project was a good illustration of the way in which new technology of benefit to the elderly and the disabled could be developed. The experience of this project could easily be applied to the development of other similar technology such as audible traffic signals, for example. The following are the recommendations of the consultants for such projects.

(1) Potential manufacturers of major components of the technology being applied should be involved in the development process from the beginning of a project.

(2) Local municipal support, including an ability and a willingness to test new technology, is essential for a successful project.

(3) Fabricators should be consulted before designs are finalized because of their experience with effective low-cost methods and material options.

(4) Alternative local sources of supply for off-the-shelf products should be considered when specifying components.

(5) If new components are required suppliers should be encouraged to cover or share in development costs.

(6) Industrial designers should strive for simplification in assembly, wiring, installation and maintenance.

(7) Industrial designers should also consider the following: environmental conditions; level of skills required for installation and maintenance; and the minimum space requirements for the components.

(8) One overall contractor should be engaged with a responsibility for the final assembly and delivery of a tested device.

The prototype device that was developed in this project has the capability to be converted to display the "WALK/WAIT" symbols on both sides of the pedestal as discussed in Section 4.2(b). Such a modification would require the power supply in the signal box to be relocated within the traffic controller cabinet as there is not sufficient space in the existing box for two lighting units and two additional power transformers needed to operate the "WALK/WAIT" symbols. (The other symbols can be operated off the existing transformers.) In any case, the relocation of the power supply is desirable because:

- Fewer transformers would be required in total since both pedestal units could operate off a single set of transformers.
- The voltage at the pedestal would be reduced from 115 volts to 24 volts, providing an additional margin of safety.
- The power supply would be better protected from weather conditions.
- Fewer electrical components would be installed in the more vulnerable pedestal box.
- The pedestal box could be more easily installed and/or replaced.

5.2 PRODUCTION REQUIREMENTS

The following are the consultants' recommendations with respect to the potential mass production of the Turtle Crosswalk device that was developed in this project.

(1) The design should be reviewed by a professional design firm and simplified whenever possible before additional units are fabricated.

(2) Mass production of the signal boxes in either mild steel or aluminum is likely to be acceptable providing that stainless steel fasteners are used throughout to resist corrosion.

(3) Access panels are required both in front and on the back for ease of maintenance and replacement of electrical components and the lexan shields.

(4) Some method of adjusting the level of the audibles should be included in the design.

(5) Fabrication and installation of the activator buttons should be simplified.

(6) More adequate weather seals are required.

(7) The LED lighting unit should be further studied and developed as a possible replacement for other traffic signal devices.

(8) The pedestal mounting system should be simplified. The signal boxes should be recessed in the concrete pedestals to resist vandalism and provide additional sun shielding.

REFERENCES

1. Student Design Competition for Pedestrian Crosswalks - An International Youth Year Project, MANOP Services Ltd., for the Transportation Development Centre, Transport Canada, March, 1986. (TP 7346E)

2. How the Turtle Crossed the Road, Student Paper by Brian Bragg Jenkins and William Thomas Reynolds, University of Alberta, Faculty of Environmental Science, Department of Industrial Design, February, 1986.

3. Pedestrian Crosswalk Systems for the Elderly and the Handicapped, MANOP Services Ltd., for the Transportation Development Centre, Transport Canada, December, 1984. (TP 5726E)

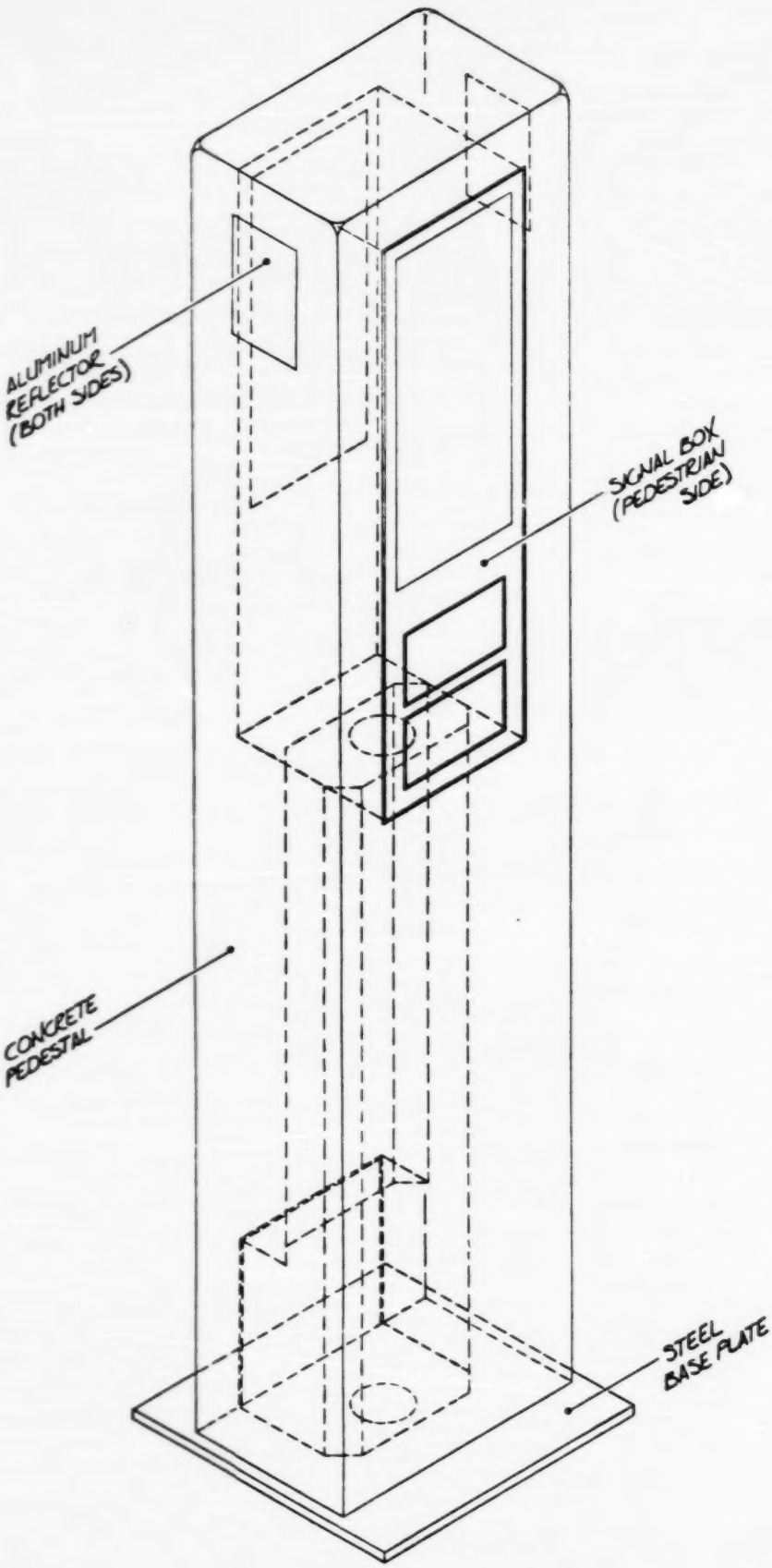
4. Canadian Capacity Guide for Signalized Intersections, Institute of Transportation Engineers, District 7 and the University of Alberta, February, 1984.

5. Manual of Uniform Traffic Control Devices for Canada, Council on Uniform Traffic Control Devices for Canada, for the Roads and Transportation Association of Canada, third edition, January, 1976.

6. Standards Publication No. TS1-1983 on Traffic Control Devices, National Electrical Manufacturers Assocation (NEMA).

APPENDIX

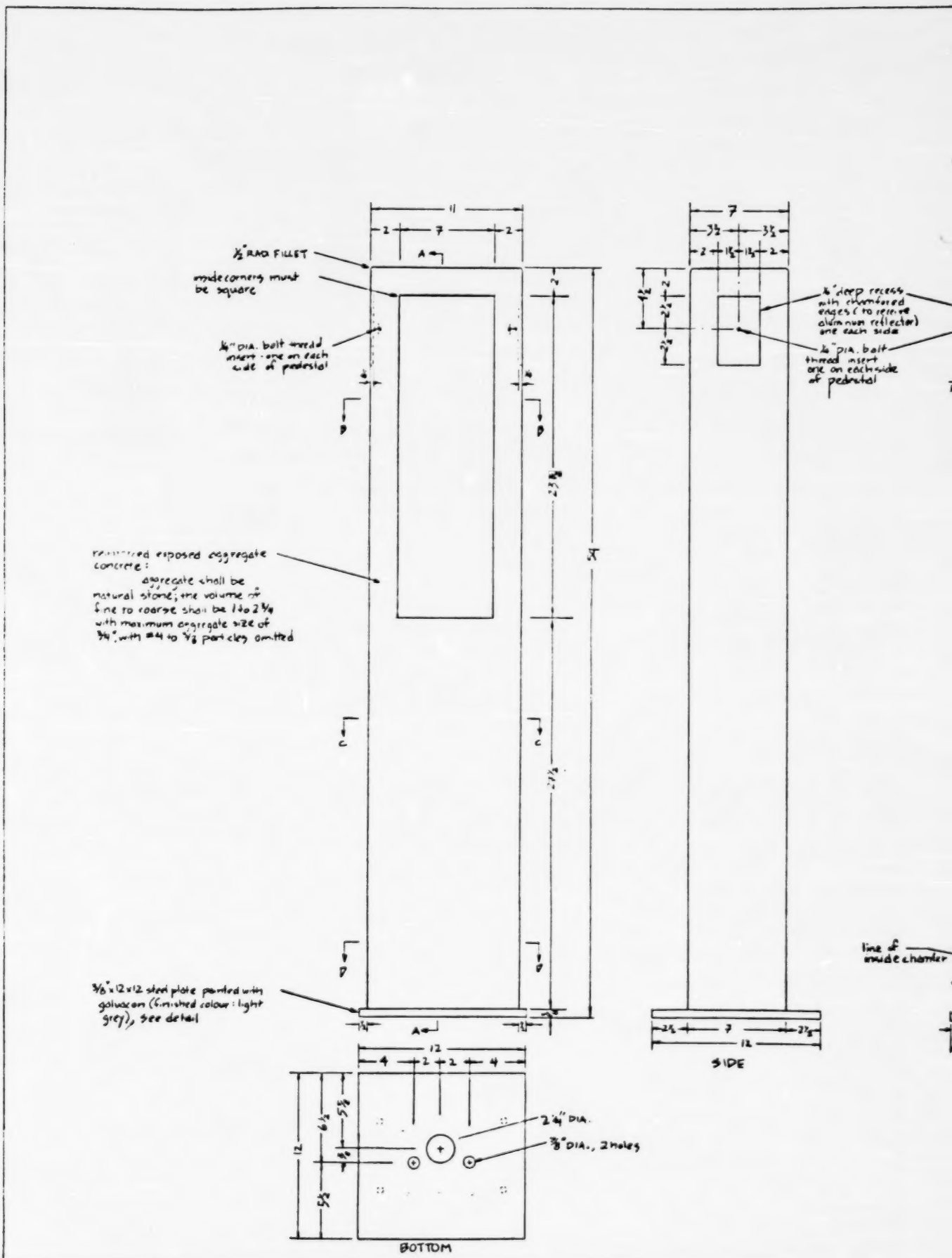
The following drawings numbered 1 through 10 illustrate the design of the prototype crosswalk signal activation device. These drawings are one-half size photo-reductions of the original drawings. The right-hand scale values must therefore be doubled when using the scales shown. For example, if the scale shows: 1/2" = 1", the actual scale is 1/2" = 2".

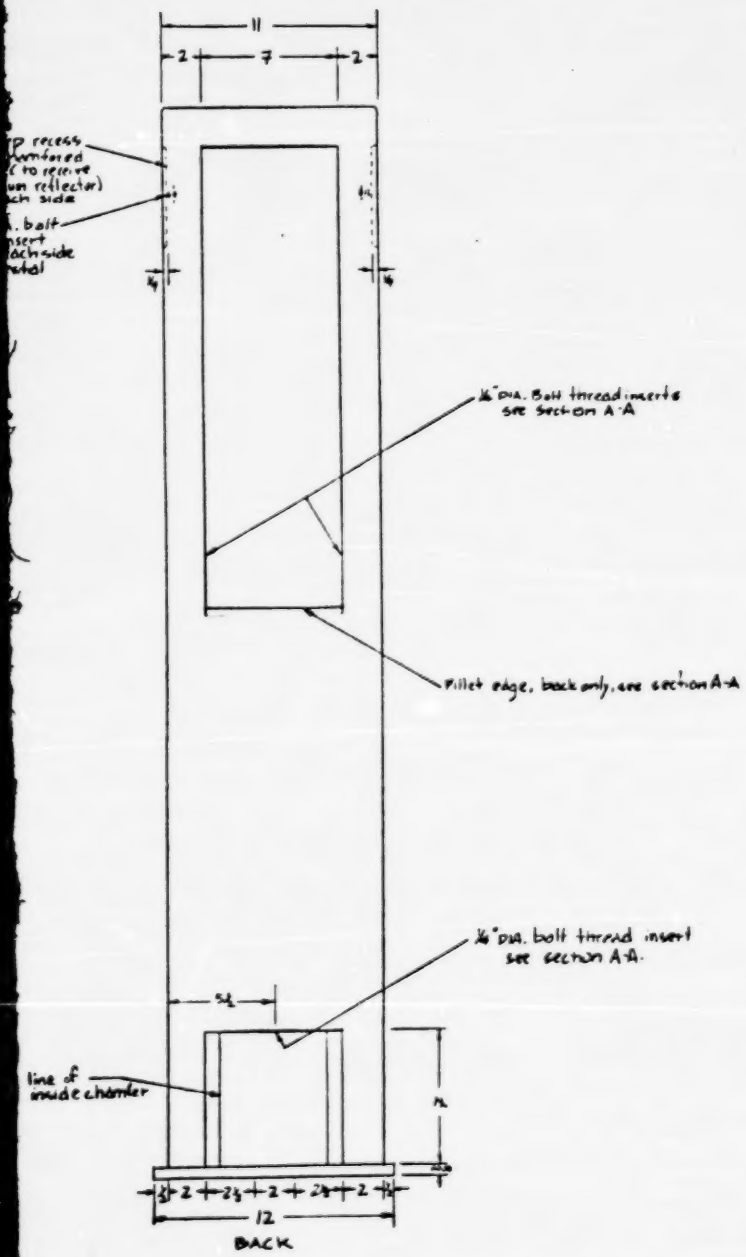

ALUMINUM
REFLECTOR
(BOTH SIDES)
SIGNAL BOX
(PEDESTRIAN
SIDE)
CONCRETE
PEDESTAL
STEEL
BASE PLATE

DWG	REV.	TITLE
1	0	PEDESTRIAN CONTROLLED - TRAFFIC SIGNAL MECHANISM
7	1	CONCRETE PEDESTAL ORTHOGRAPHICS
8	1	SECTIONS, DETAILS OF CONCRETE PEDESTAL
9	2	CONCRETE FOOTINGS FOR PEDESTAL
19	2	ACCESS DOOR AND HINGE
20	0	LINE MARKINGS AND PEDESTAL PLACEMENT
21	0	EXTERIOR SIDES OF SIGNAL BOX
22	1	MICRO SWITCH ACTUATOR ASSEMBLY
23	1	SIGNAL BOX - SECTION AND DETAILS
24	1	SIGNAL BOX - SECTION AND BRACKET DETAILS
25	0	SIGNAL BOX SHIELDS AND ACTUATOR BUTTONS

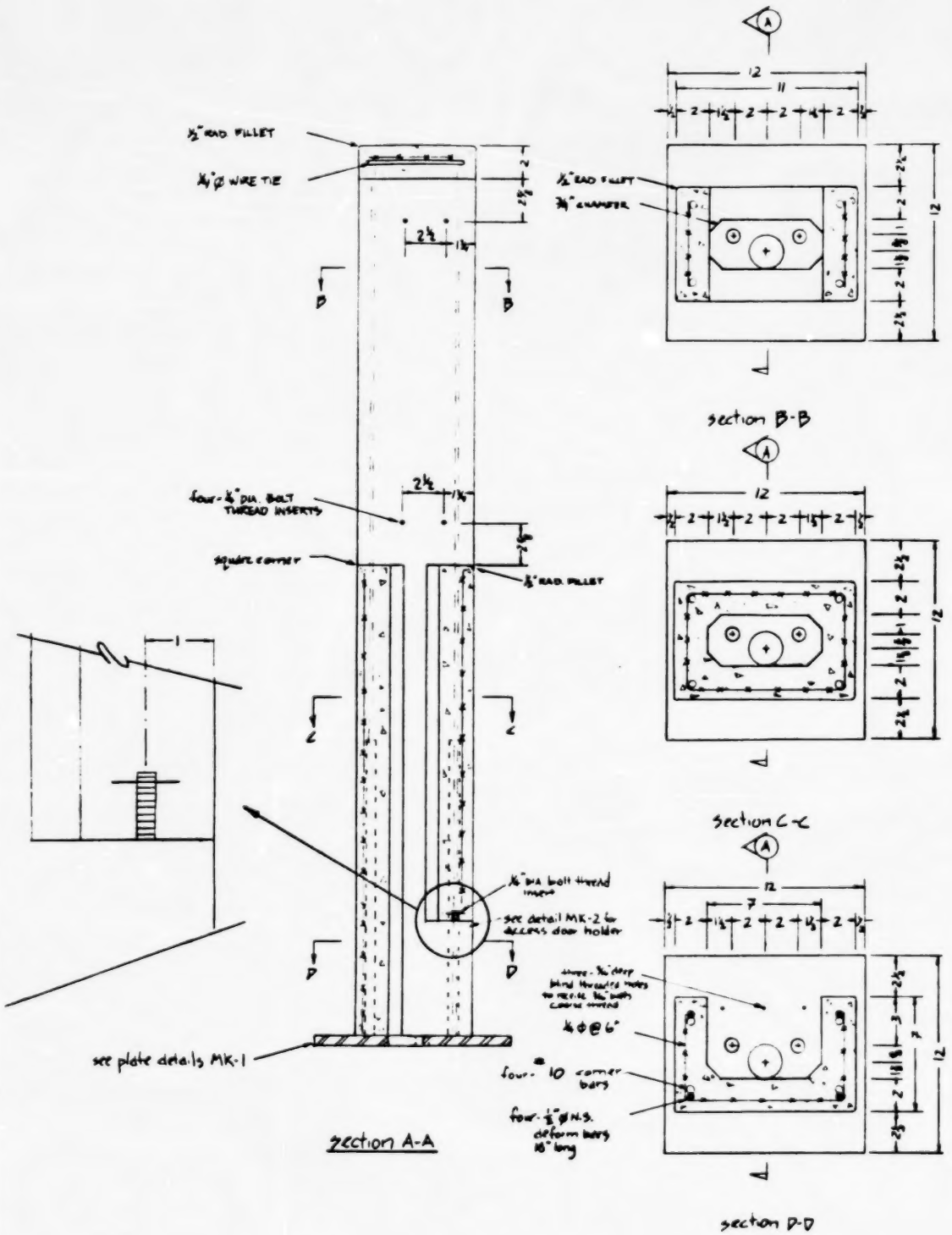
MATERIAL	ITEM DESCRIPTION	FINISH
REINFORCED CONCRETE	PEDESTAL	EXPOSED AGGREGATE
MILD STEEL	PEDESTAL BASE PLATE	GALVACON PAINT
MILD STEEL	ACCESS DOOR AND HOLDER	POWDER COATED
MILD STEEL	SIGNAL BOX AND FLANGES	POWDER COATED
MILD STEEL	ACTUATOR ASSEMBLY	POWDER COATED
MILD STEEL	SIGNAL AND TERMINAL BRACKETS	POWDER COATED
LEXAN (POLYCARBONATE)	SIGNAL BOX SHIELDS	CLEAR UNTINTED
LAMINATED MAPLE	ACTUATOR BUTTONS	NATURAL

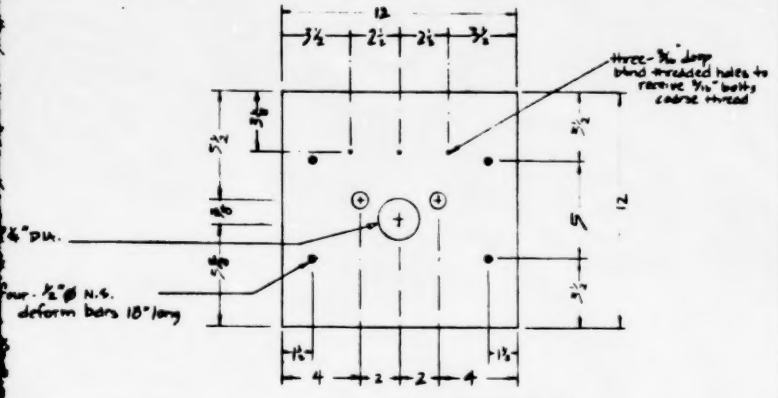
				MANOP SERVICES LTD.			
				PEDESTRIAN CONTROLLED - TRAFFIC SIGNAL MECHANISM			
				SCALE - 1" to 3"	DESIGN - B.B. JENKINS N.T. REYNOLDS A.C. DISSING	REV.	DWG. 1
				DATE - NOV. 10/86			
				DRAWN - A. DISSING			


½" RAD FILLET
inside corners must be square
¼" DIA. bolt thread insert - one on each side of pedestal
reinforced exposed aggregate concrete:
aggregate shall be natural stone; the volume of fine to coarse shall be 1 to 2¾ with maximum aggregate size of ¾", with #4 to ⅜ particles omitted
⅜"x12x12 steel plate painted with galvacon (finished colour: light grey), see detail
¼" deep recess with chamfered edges (to receive aluminum reflector) one each side
¼" DIA. bolt thread insert one on each side of pedestal
line of inside chamber
SIDE
2¼" DIA.
⅜" DIA., 2 holes
BOTTOM

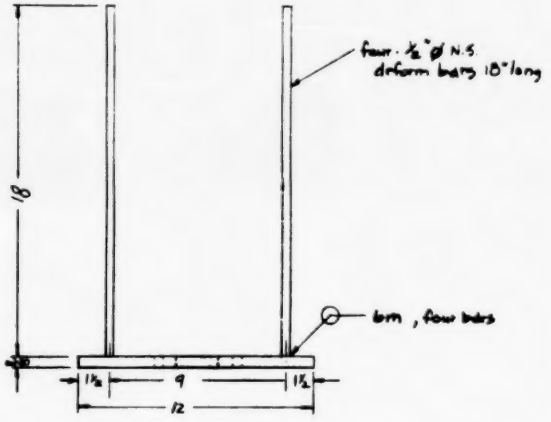


				MANOP SERVICES LTD.			
				CONCRETE PEDESTAL			
		⚠ BBJ OCT. 6/86	REVISED HOLE FOR POWER CONDUIT.	SCALE – 1/4" to 1"	DESIGN – B.B. JENKINS N.T. REYNOLDS	REV. 2	DWG. 2
		⚠ BBJ OCT. 7/86	REVISED INSERTS, RECESS	DATE – SEPT. 25/86			
				DRAWN – B. JENKINS			

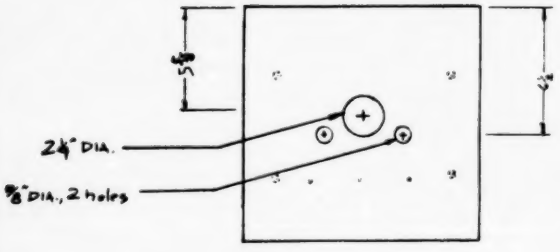

½" RAD FILLET
¼" Ø WIRE TIE
2½
2½
1½
B
B
four - ¾" DIA. BOLT THREAD INSERTS
square corner
½" RAD FILLET
1
C
C
¾" DIA bolt thread insert
see detail MK-2 for access door holder
D
D
see plate details MK-1
section A-A
A
12
11
½ 2 1½ 2 2 4 2 ½
½" RAD FILLET
¾" CHAMFER
2½
2
2
1½
1½
2
2½
12
section B-B
A
12
½ 2 1½ 2 2 1½ 2 ½
2½
2
1
1½
2
2½
12
section C-C
A
12
7
½ 2 1½ 2 2 4½ 2 ½
three - ⅝" deep blind threaded holes to receive bolts (same material)
4 @ 6"
four - #10 corner bars
four - ½" Ø N.S. deform bars 18" long
2½
3
2
1½
2
2½
12
section D-D
scale: ¾" = 1"



TOP - PLATE DETAIL MK-1

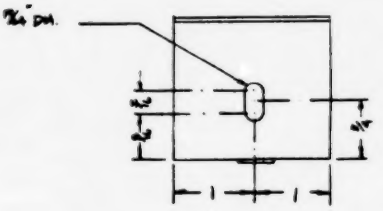


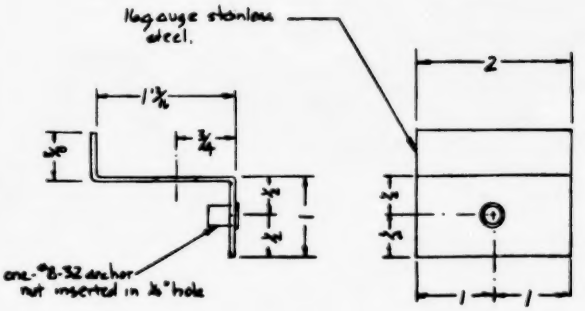
FRONT - PLATE DETAIL MK-1



BOTTOM - PLATE DETAIL MK-1

DETAILS MK-1 scale: 1/2" = 1"





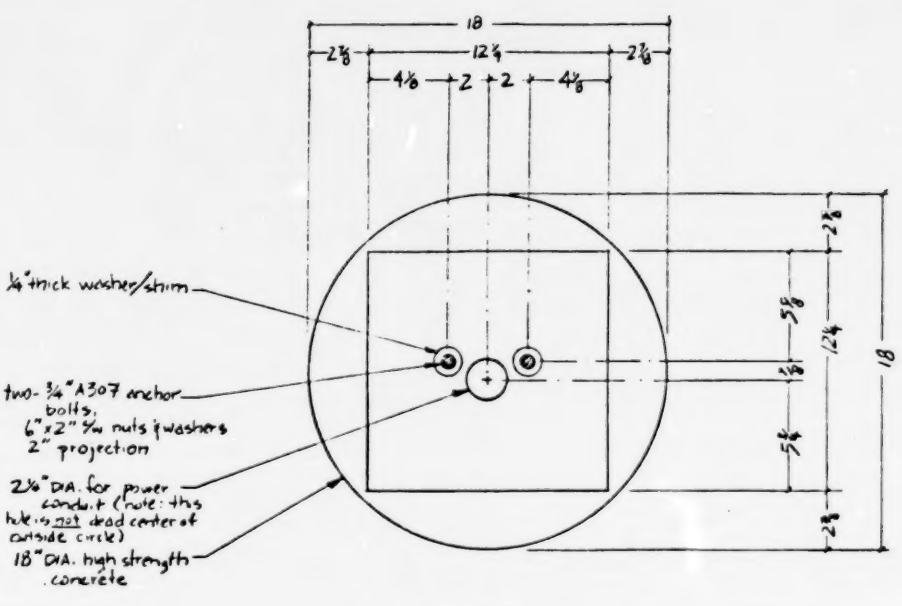
SIDE

FRONT - DETAIL MK-2 ACCESS DOOR HOLDER

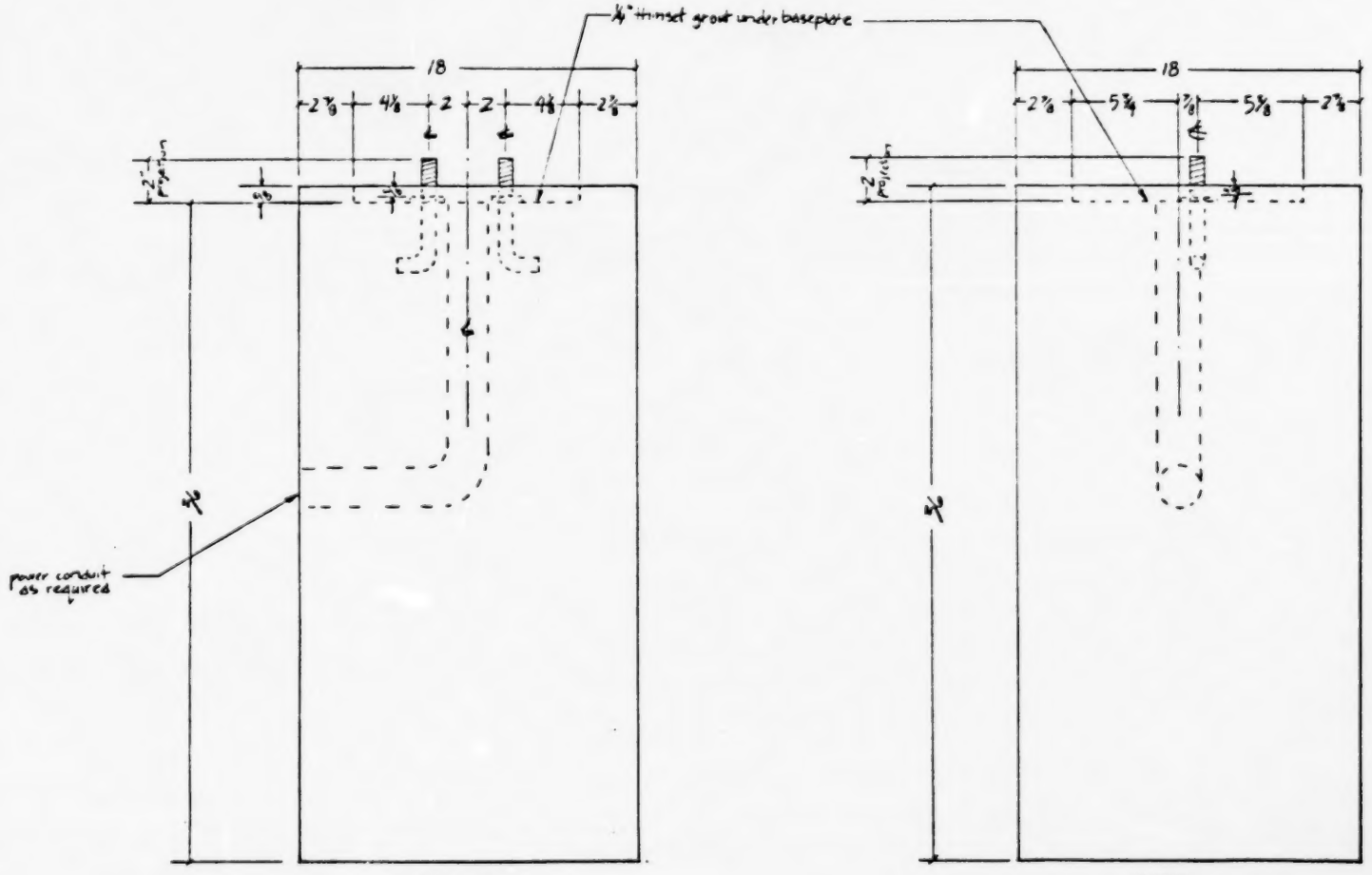
* NOTE: this access door holder will be supplied by MANOP and added to concrete pedestal on site.

DETAILS MK-2 scale: 1" = 1"

			MANOP SERVICES LTD.
			SECTIONS & DETAILS OF CONCRETE PEDESTAL
BBJ OCT. 7/86	REVISED SIZE OF HOLE FOR POWER CONDUIT.	SCALE - AS SHOWN	DESIGN - B.B. JENKINS N.T. REYNOLDS
BBJ OCT 2/86	REVISED HOLDER, INSERT & BARS	DATE - SEPT. 25/86	REV. 2
		DRAWN - B JENKINS	DWG 3

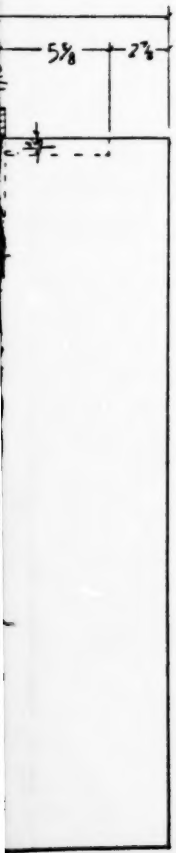


TOP

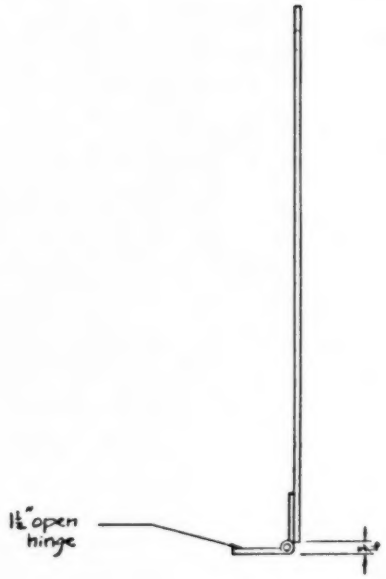


FRONT

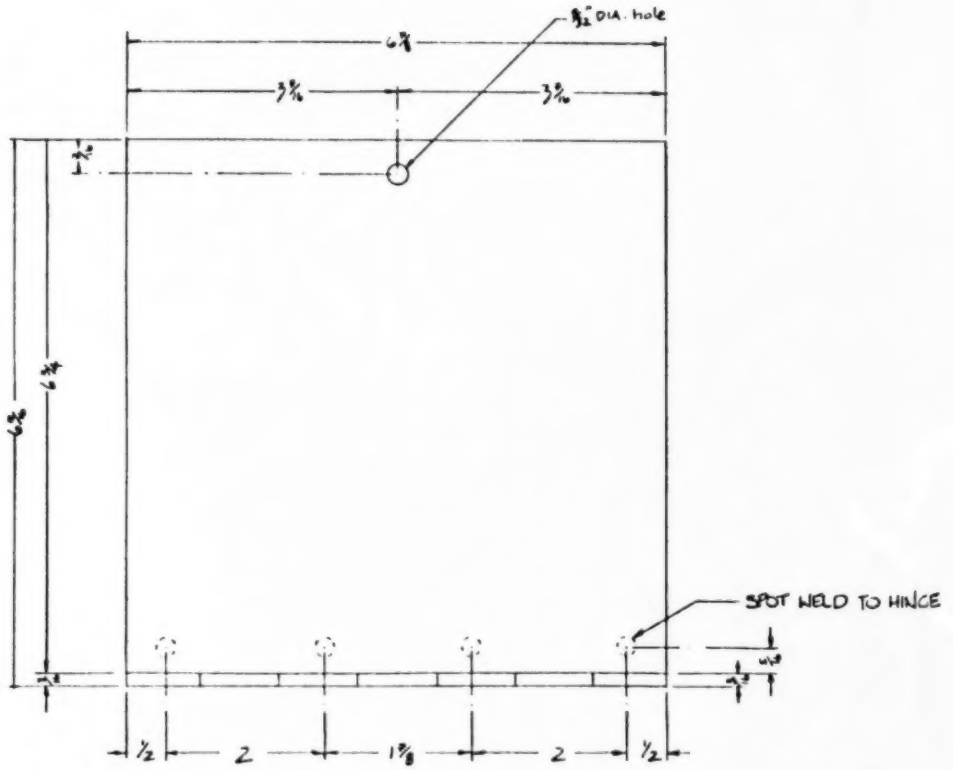
SIDE



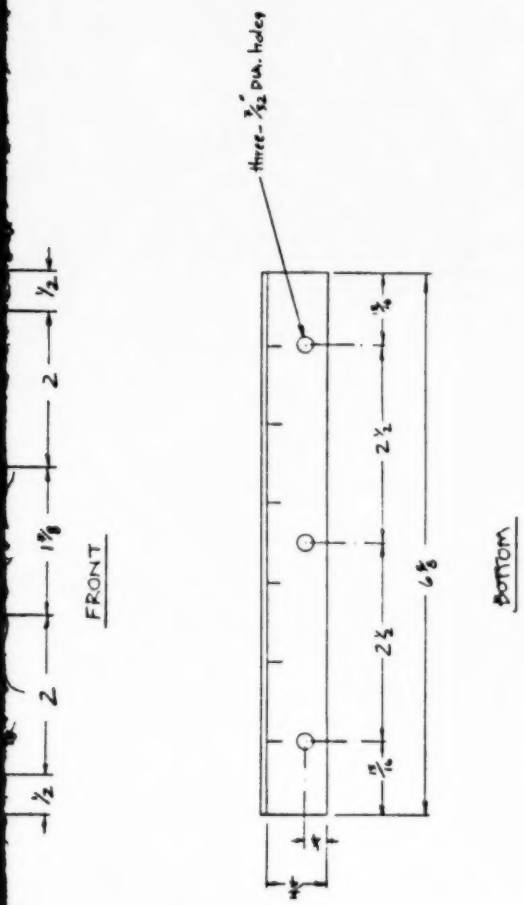
		MANOP SERVICES LTD.			
⚠ BBJ OCT. 9/86	REVISED OUTER SHAPE.	CONCRETE FOOTINGS FOR PEDESTAL			
⚠ BBJ OCT. 6/86	REVISED SIZE OF POWER CONDUIT.	SCALE - 1/4" to 1"	DESIGN - B.B JENKINS N.T. REYNOLDS	REV. 3	DWG. 4
⚠ BBJ OCT. 2/86	REVISED RECESS, BARS.	DATE - SEPT. 26/86			
		DRAWN - B. JENKINS			



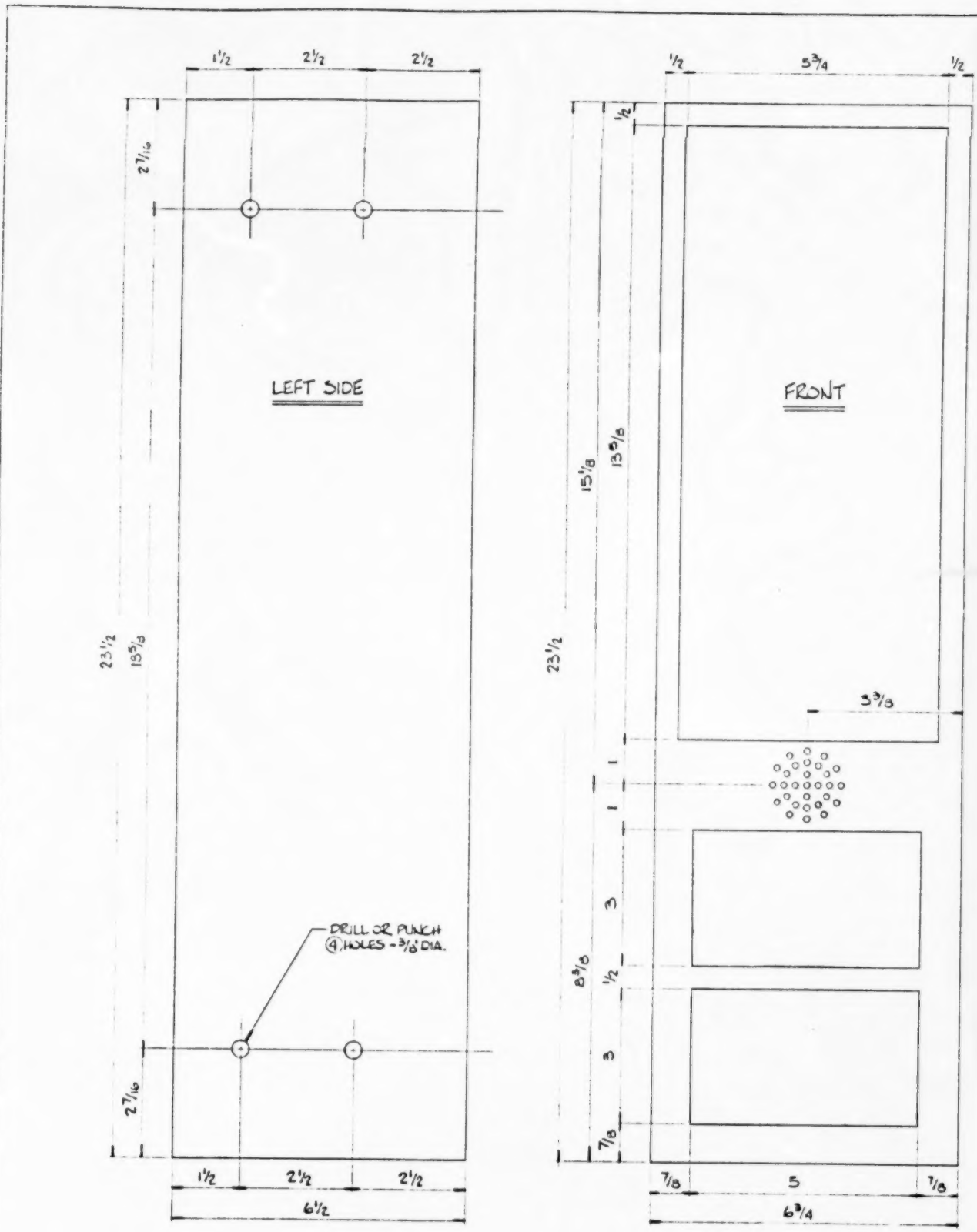
SIDE

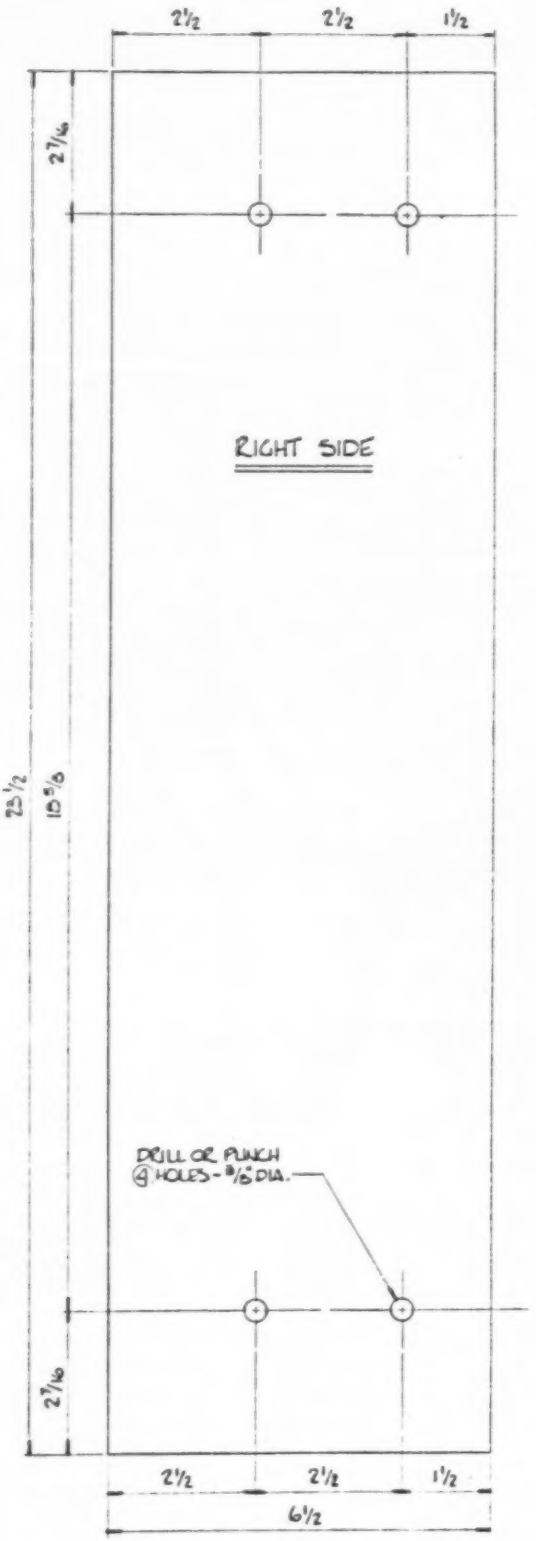


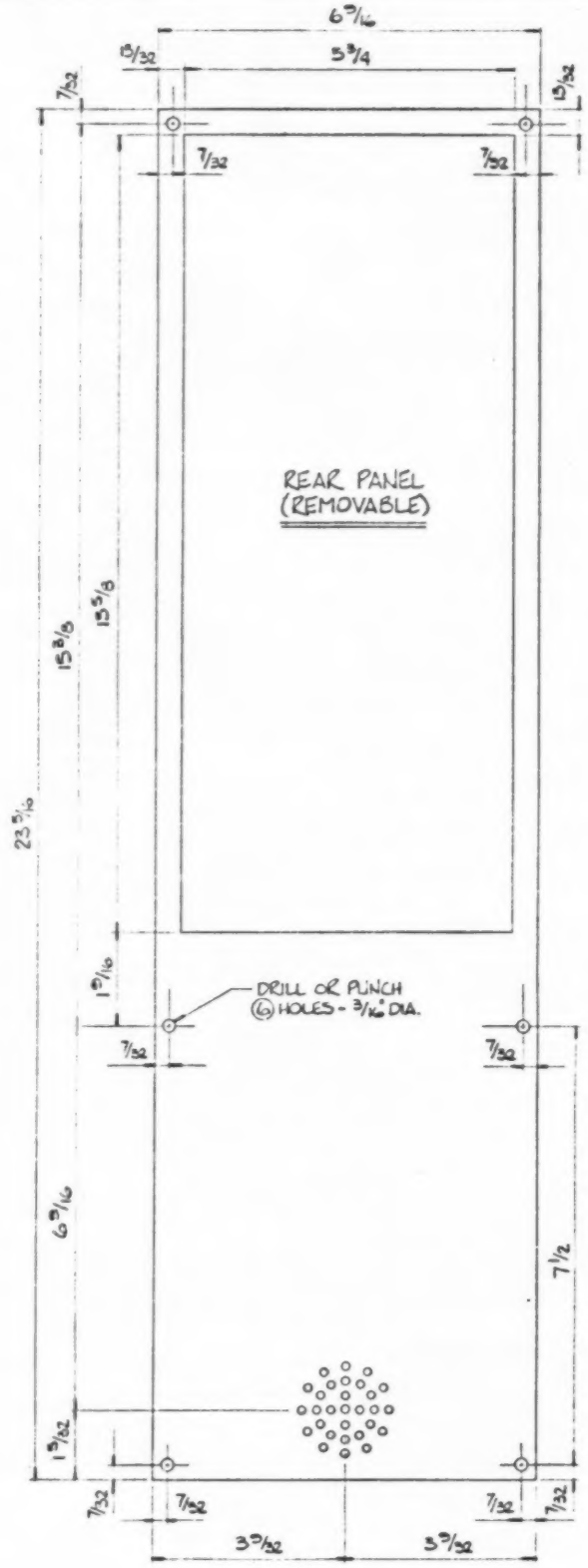
FRONT



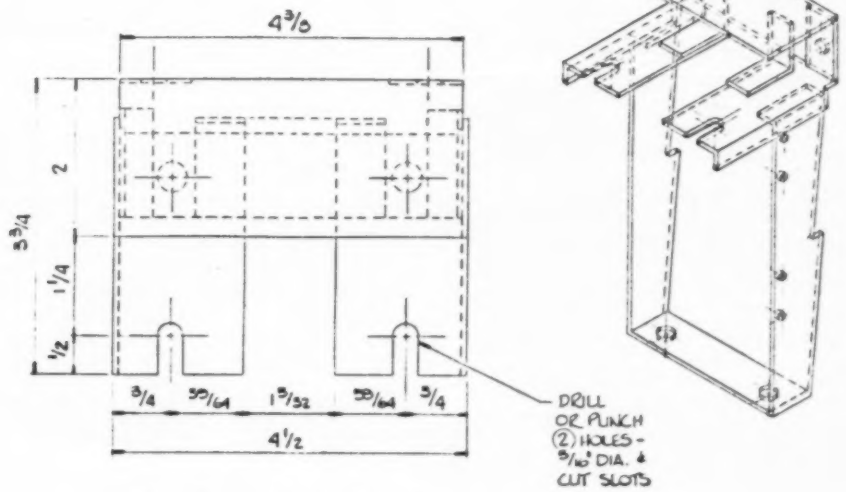
				MANOP SERVICES LTD.			
				PEDESTAL ACCESS DOOR & HINGE			
		⚠ AD OCT. 16/86	DELETE STUDS, MATERIAL CHANGE.	SCALE – FULL SIZE	DESIGN – B.B. JENKINS W.T. REYNOLDS	REV.	DWG.
		⚠ BBJ NOV. 19/86	(4) STUDS ADDED.	DATE – OCT. 2/86		2	5
				DRAWN – B. JENKINS			

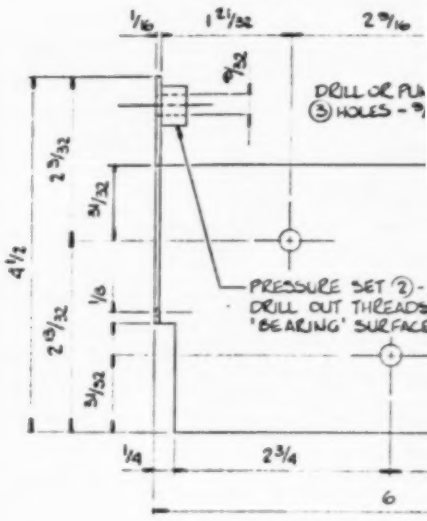

1½
2½
2½
2 7/16
LEFT SIDE
23½
13⅝
DRILL OR PUNCH
④ HOLES - ⅜" DIA.
2 7/16
1½
2½
2½
6½
½
5¾
½
½
15⅛
13⅝
FRONT
23½
5⅜
1
1
3
⅝
3
⅞
7/8
5
7/8
6¾



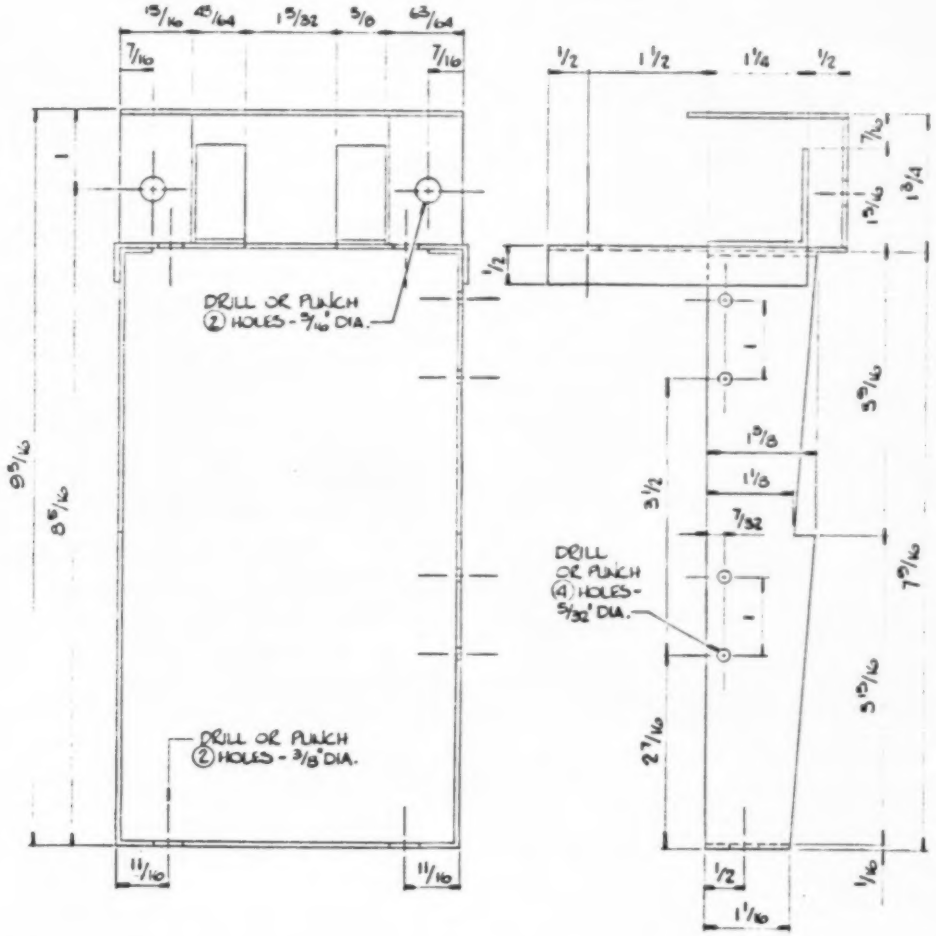


				MANOP SERVICES LTD.			
				EXTERIOR SIDES OF SIGNAL BOX			
				SCALE - 3/4" to 1"	DESIGN - B.B. JENKINS N.T. REYNOLDS A.C. DISSING	REV.	DWG.
				DATE - NOV. 1, 86		1	6
		⚠ D DEC 1, 86	REAR PANEL OUTSIDE DIM. REVISED	DRAWN - A.DISSING			

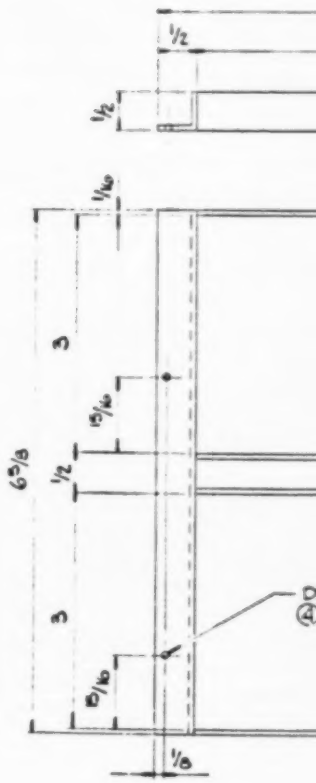




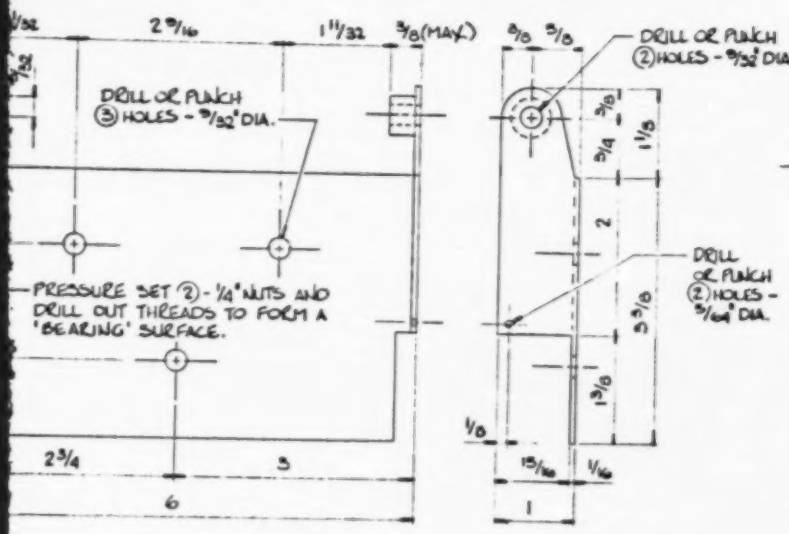
ACTUATOR



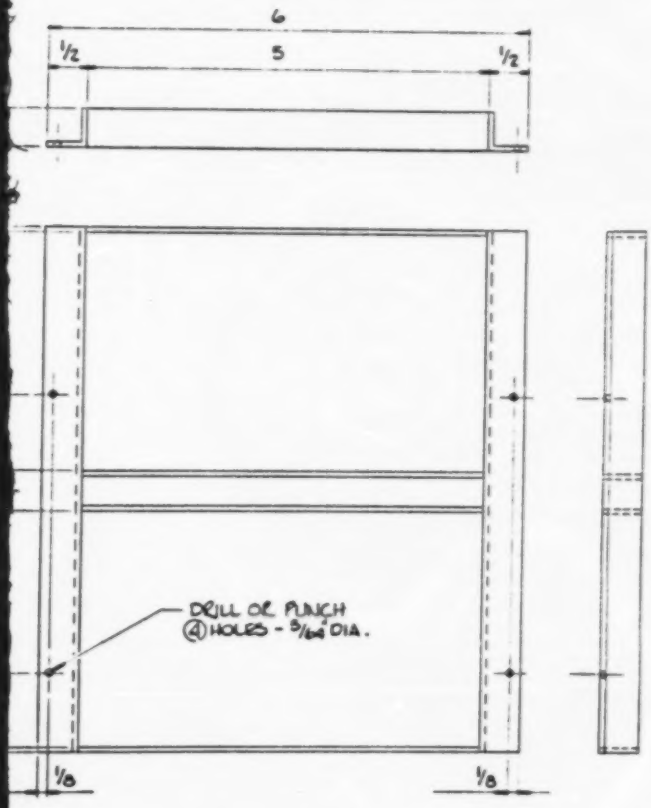
ACTUATOR GUARD



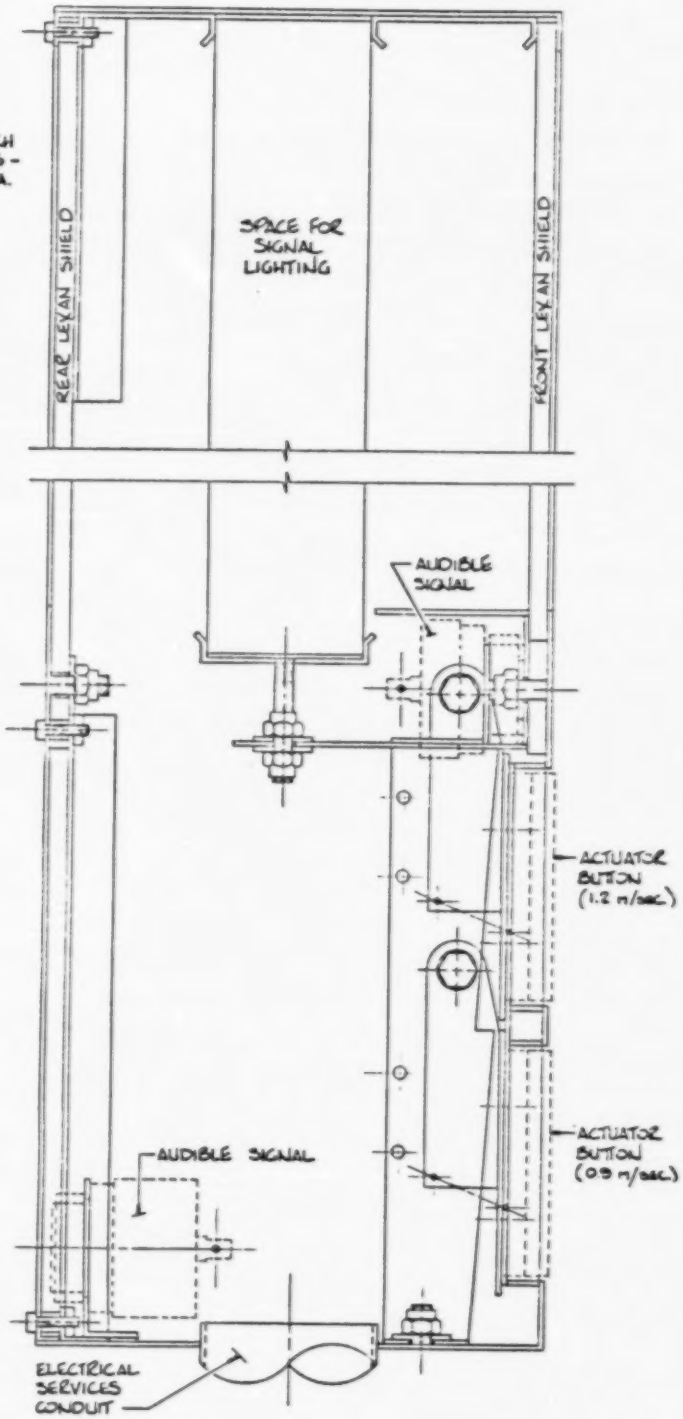
ACTUAT



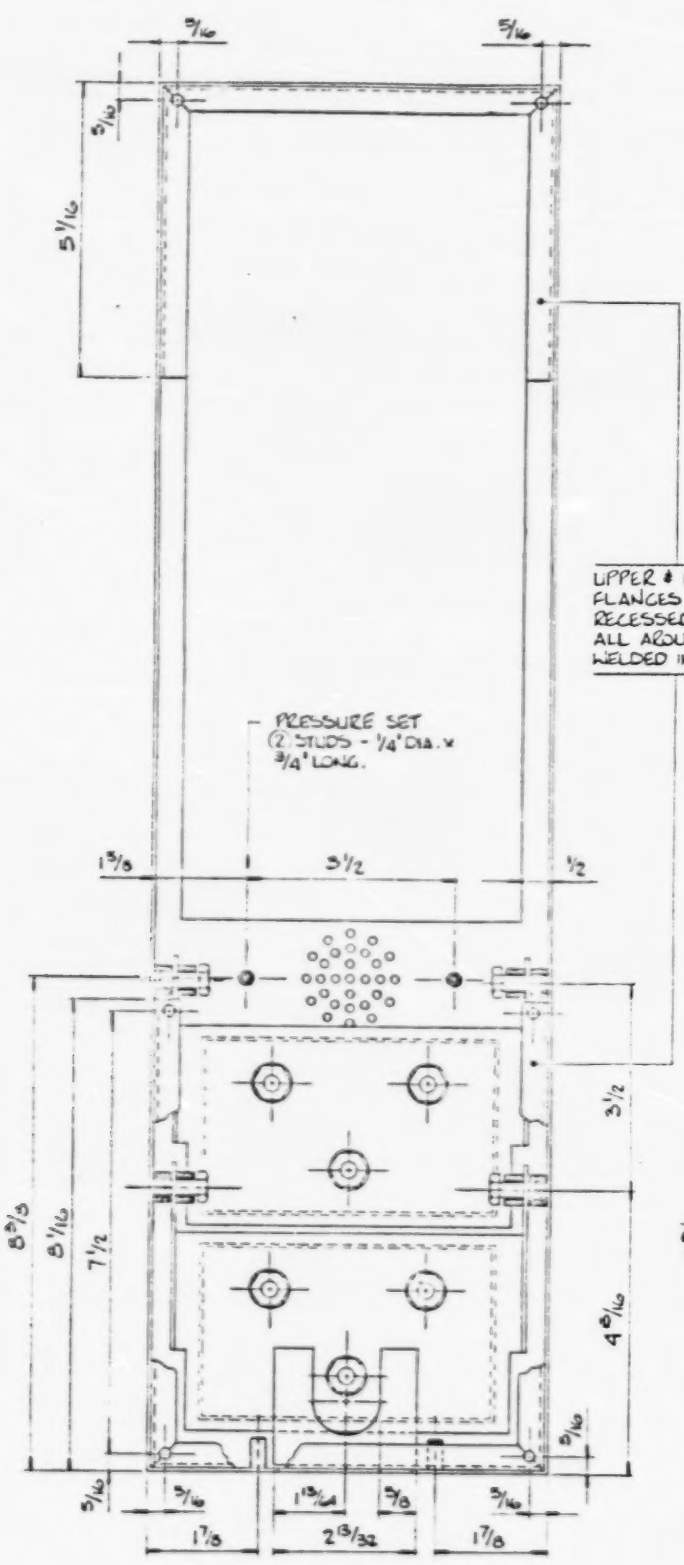
ACTUATOR (2 REQ'D)



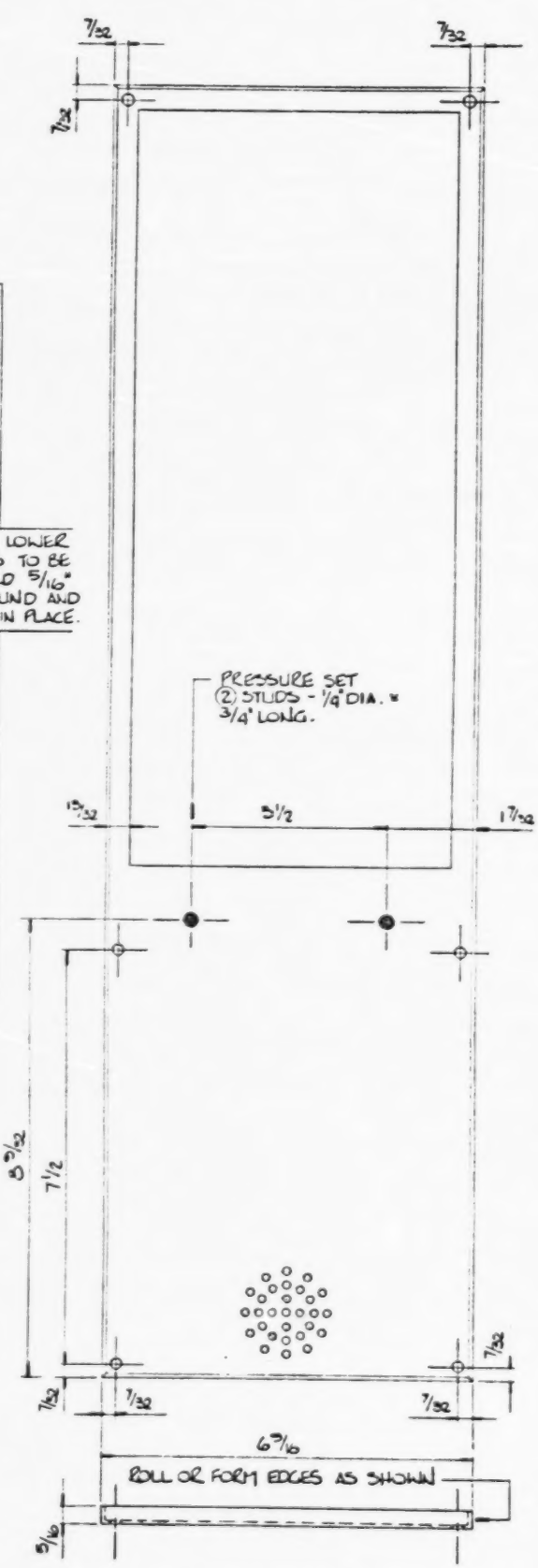
ACTUATOR REINFORCEMENT



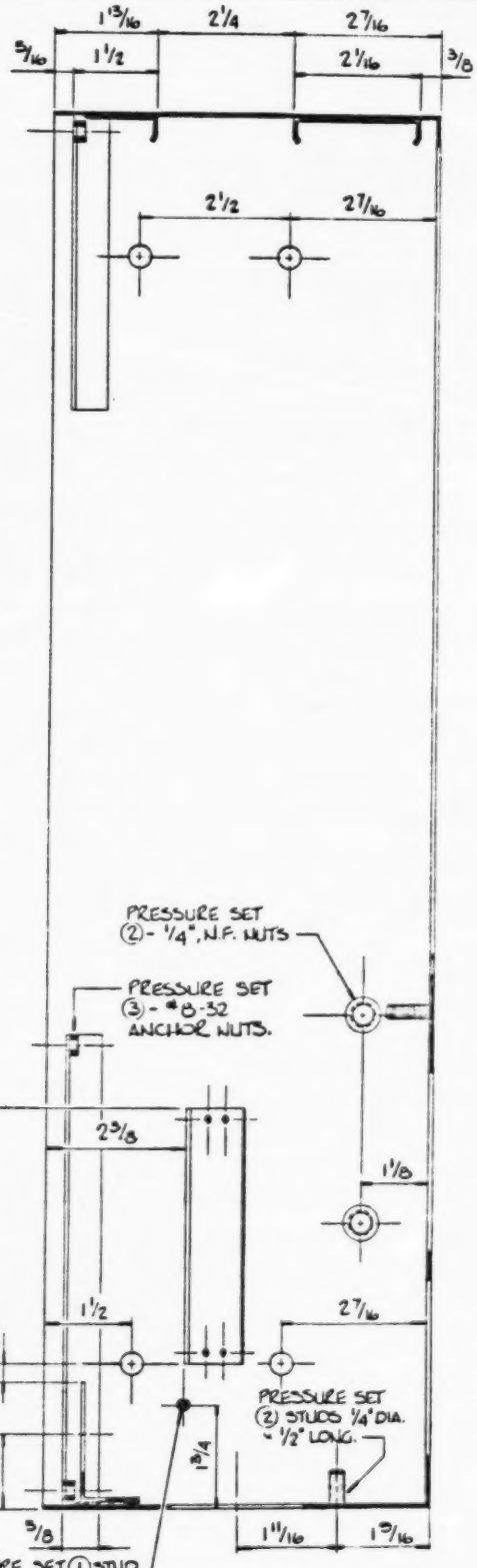
				MANOP SERVICES LTD.		
				MICRO SWITCH ACTUATOR ASSEMBLY		
				SCALE - FULL SIZE	REV.	DWG.
				DATE - NOV. 1, 86	1	7
				DRAWN - A. DISSING		
		1	ACTUATOR AND GUARD REVISED AND DETAILED. NOV. 11/86	DESIGN - B.B. JENKINS, N.T. REYNOLDS, A.C. DISSING		



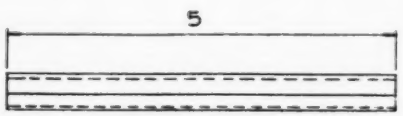
BACK VIEW OF SIGNAL BOX w/ REAR PANEL REMOVED

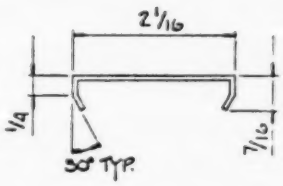


INSIDE VIEW REAR PANEL

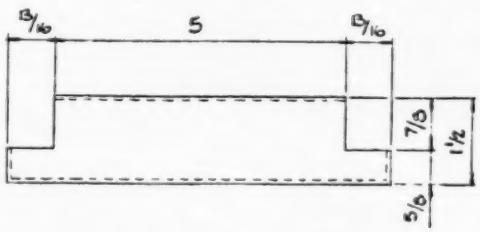


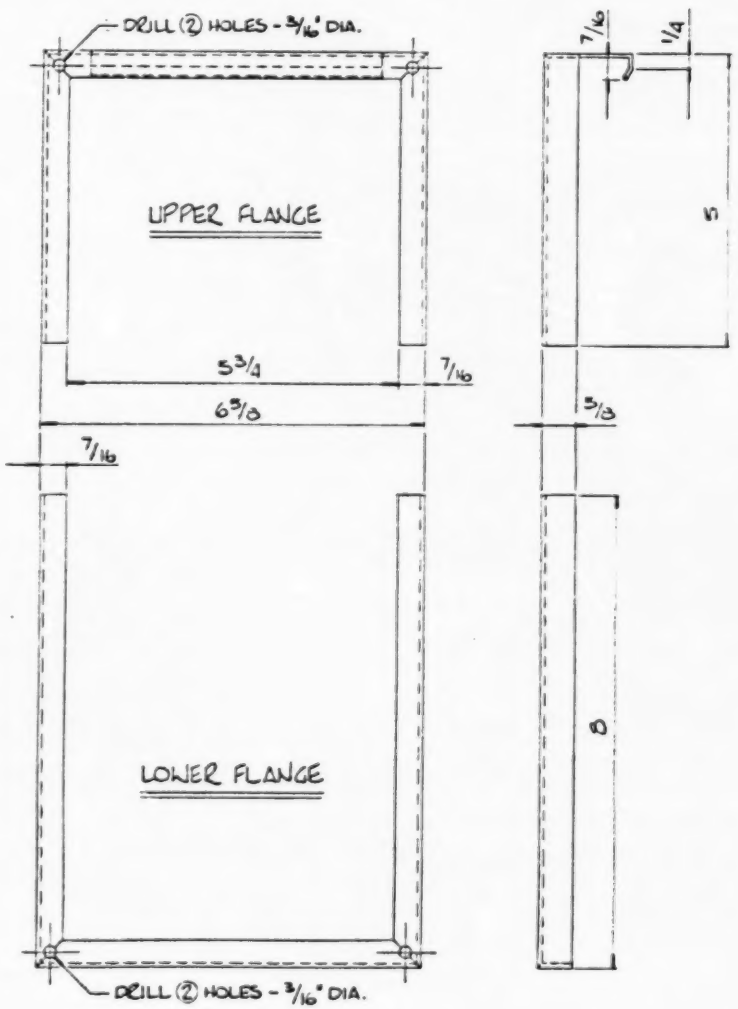
SIGNAL BOX - SECTION



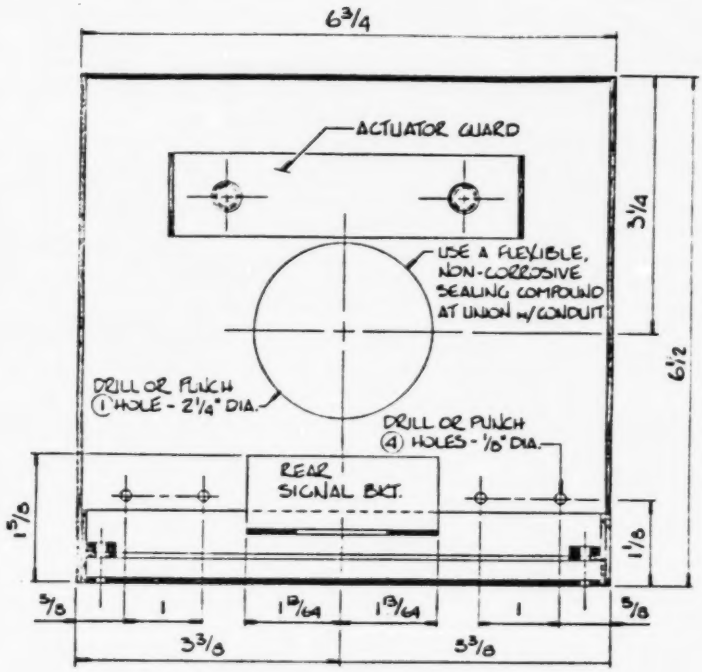


GUIDE (SCALE: FULL SIZE)

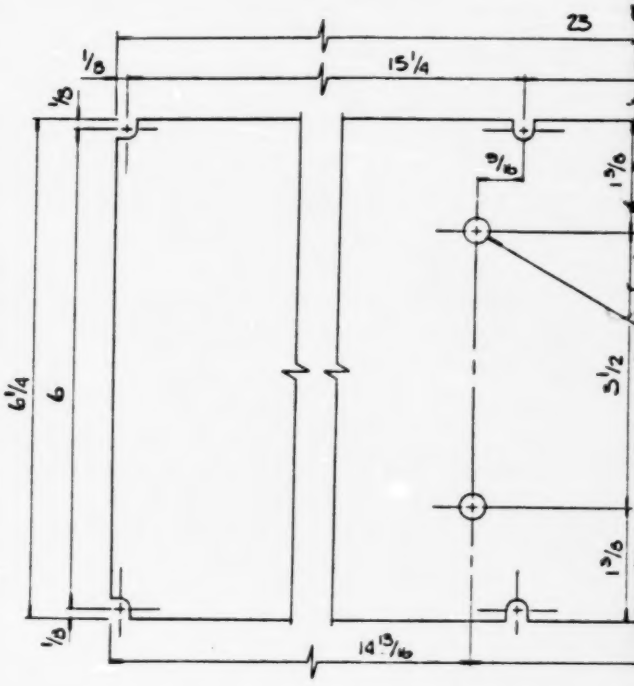




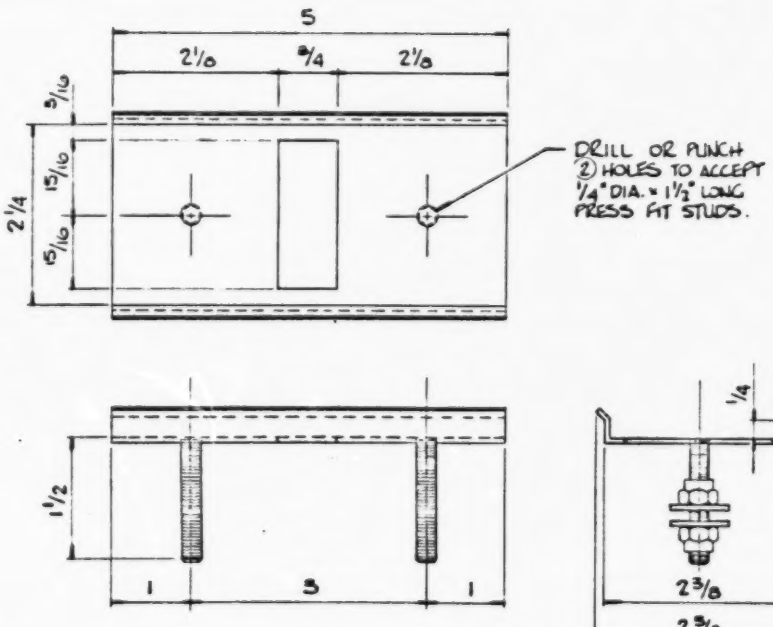
				MANOP SERVICES LTD.			
				SIGNAL BOX - SECTION & DETAILS			
				SCALE - 3/4" to 1"	DESIGN - B.B. JENKINS, N.T. REYNOLDS, A.C. DISSING	REV.	DWG.
				DATE - NOV. 1, 86		1	8
		⚠ AD NOV. 10/86	HELD ON NUTS TO PRESS-SET & DRILL PATTERN REV.	DRAWN - A. DISSING			



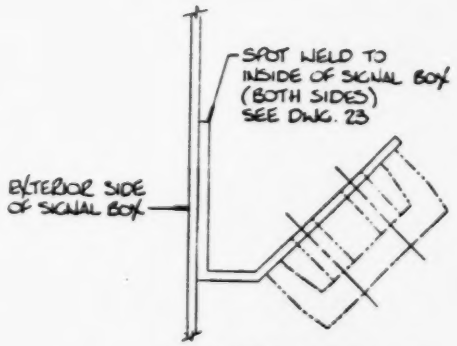
BIH VIEW SIGNAL BOX - SECTION



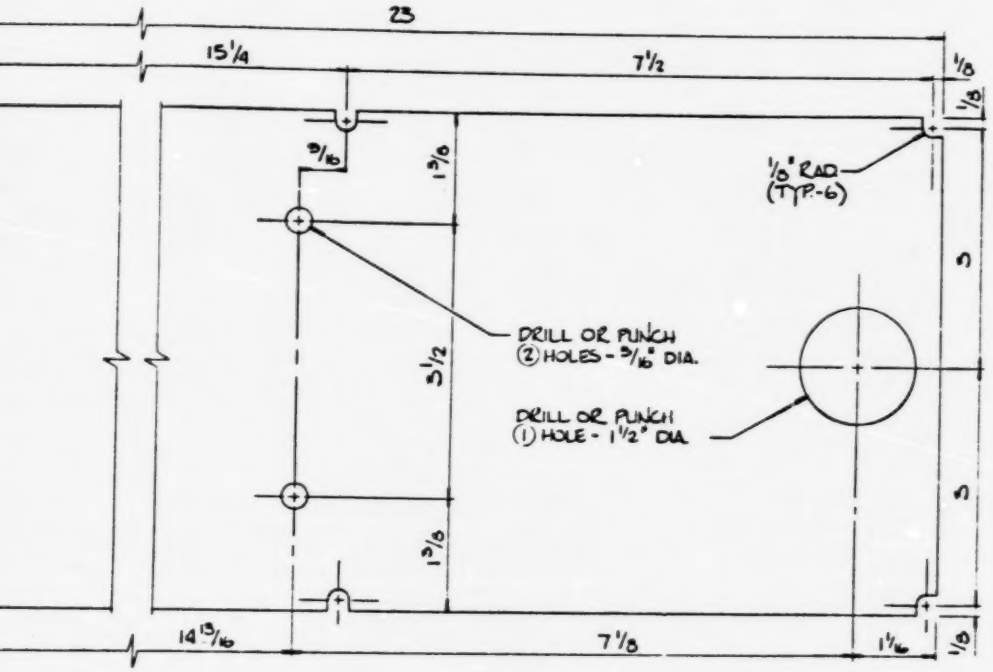
REAR PANEL INNE



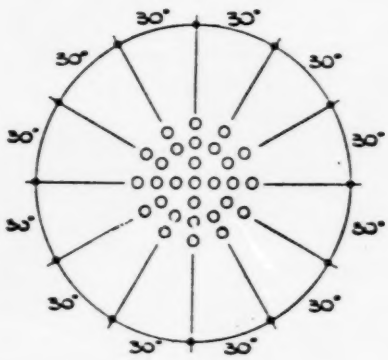
TRAFFIC SIGNAL - SUPPORT BRACKET



ENLARGED TOP VIEW OF BRACKET W/ TERMINAL CONNECTOR IN PLACE.

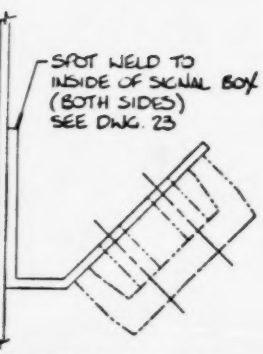


REAR PANEL INNER PLATE (1/8" THICK W/ SPACERS TO SUIT RECESSED FLANGES.)

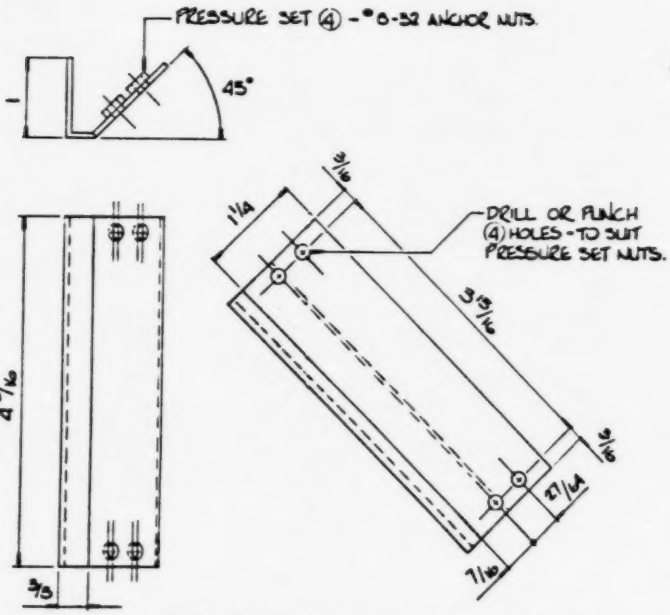


SPEAKER GRILL PATTERN

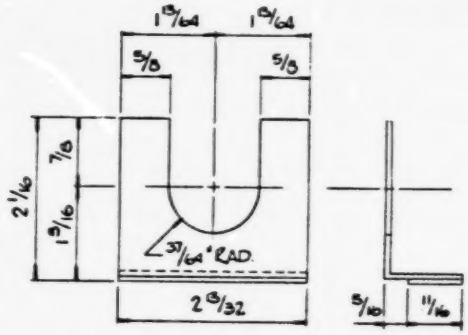
DRILL OR PUNCH (29) HOLES - 1/8" DIA 1/4" APART CENTER TO CENTER, ALONG 30° RADIUS LINES.



ENLARGED TOP VIEW OF BRACKET W/ TERMINAL CONNECTOR IN PLACE.

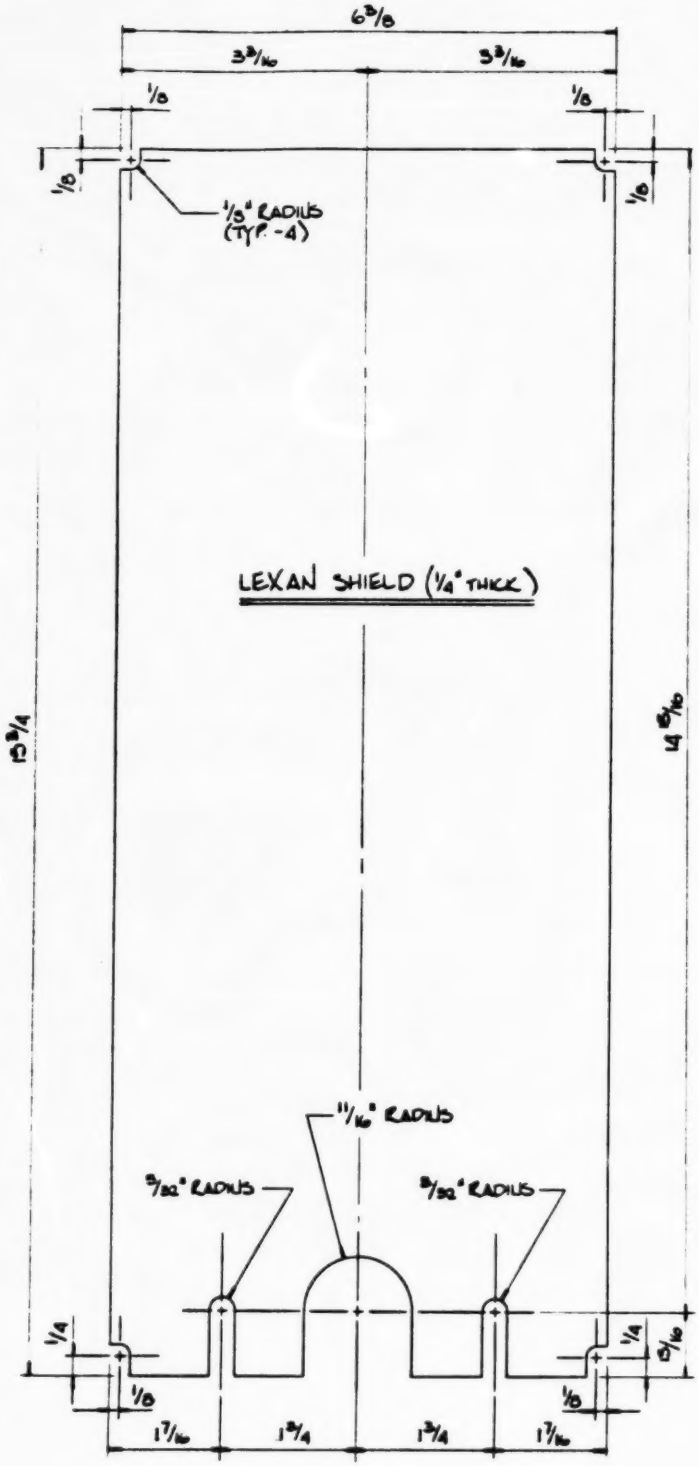


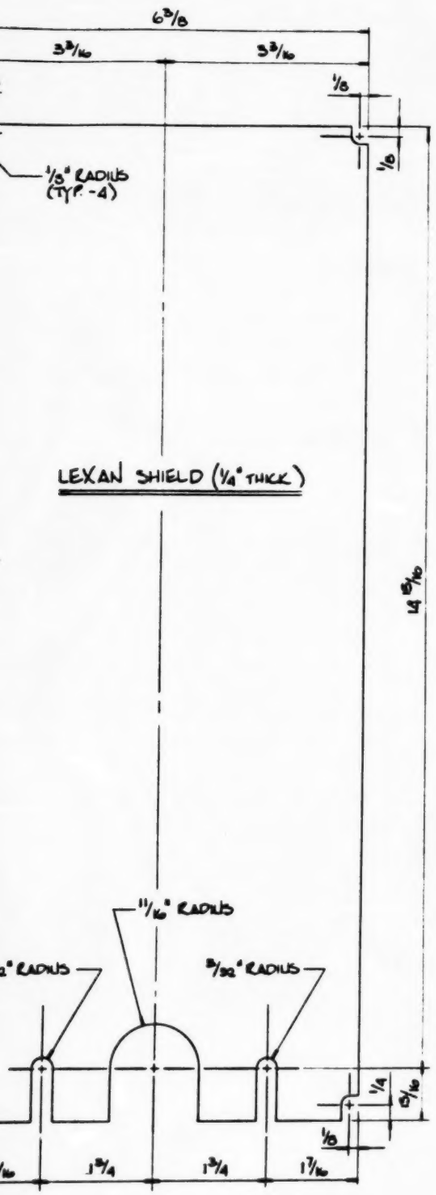
TERMINAL BLOCK BRACKET (2 REQ'D)

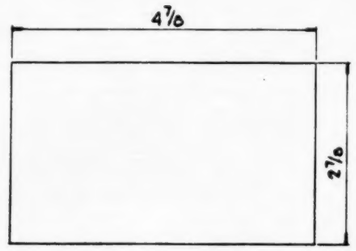


8TH REAR SIGNAL - BRACKET

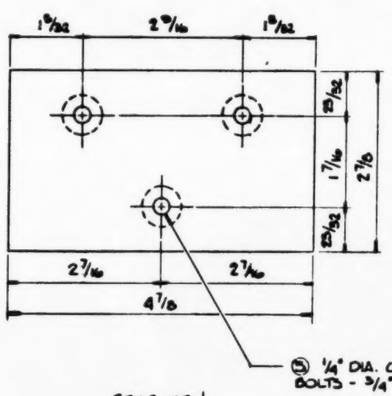
				MANOP SERVICES LTD.			
				SIGNAL BOX - SECTION & BRACKET DETAILS			
				SCALE - FULL SIZE	DESIGN - B.B. JENKINS W.T. REYNOLDS A.C. DISSING	REV.	DWG
				DATE - NOV. 1, 86		1	9
		1	BLOCK BKT. W/ ANCHOR NUTS	DRAWN - A. DISSING			
		NOV. 10/86	PT. THICKNESS & GRILL.				

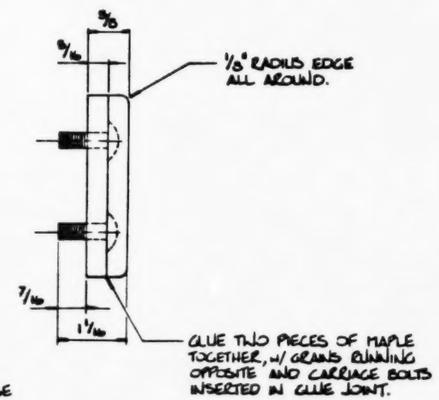

6 3/8
3 3/16
3 3/16
1/8
1/8
1/8
1/8
1/8" RADIUS
(TYP. -4)
LEXAN SHIELD (1/4" THICK)
15 3/4
14 15/16
11/16" RADIUS
3/32" RADIUS
3/32" RADIUS
1/4
1/4
5/16
1/8
1/8
1 7/16
1 3/4
1 3/4
1 7/16





FRONT VIEW




3/8
9/16
1/8" RADIUS EDGE ALL AROUND.
7/16
1 7/16
GLUE TWO PIECES OF MAPLE TOGETHER, W/ GRAINS RUNNING OPPOSITE AND CARRIAGE BOLTS INSERTED IN GLUE JOINT.

REAR VIEW

ACTUATOR BUTTON (2 REQ'D) - SUPPLIED BY MANOP SERVICES LTD.

				MANOP SERVICES LTD.			
				SIGNAL BOX SHIELDS AND ACTUATOR BUTTONS.			
				SCALE - FULL SIZE	DESIGN - B.B. JENKINS W.T. REYNOLDS A.C. DISSING	REV.	DWG. 10
				DATE - NOV. 10/86			
				DRAWN - A. DISSING			